

Riverine Ironclads, Submarines, and Aircraft Carriers of the American Civil War

Patrick H. Stakem

(c) 2019

| | |
|---------------------------------------|----|
| Introduction..... | 8 |
| Author..... | 9 |
| Background..... | 9 |
| Who's who..... | 10 |
| Joseph Reid Anderson..... | 10 |
| William Alexander..... | 10 |
| W. L. Barnes..... | 10 |
| Judah P. Benjamin..... | 10 |
| Col. George Bomford..... | 10 |
| John Mercer Brooke..... | 10 |
| Admiral Franklin Buchanan..... | 11 |
| Cornelius Bushnell..... | 11 |
| Major General Benjamin F. Butler..... | 11 |
| W. M. Cheeney..... | 11 |
| Clive Clusler..... | 11 |
| William Cramp..... | 11 |
| John A. Dahlgren..... | 12 |
| Cornelius H. DeLamater | 12 |
| A. & W. Denmead..... | 12 |
| Lt. George E. Dixon..... | 12 |
| E. P. Doer..... | 12 |
| James Buchanan Eads..... | 12 |
| Samuel Eakins..... | 13 |
| John Ericsson..... | 13 |
| Admiral David Farragut..... | 13 |
| Gustavus V. Fox..... | 13 |
| Frances H. Gregory..... | 13 |
| John Halligern..... | 13 |
| Horstford, Professor..... | 14 |
| Horace Hunley..... | 14 |
| Edward B. Hunt..... | 14 |
| Benjamin F. Isherwood | 14 |
| Catesby ap Roger Jones | 14 |
| Julius Krorhl | 14 |
| Private Charles P. Leavitt, | 14 |
| John Lenthall..... | 15 |
| Corporal John Mackie, | 15 |

| | |
|--|----|
| Stephen R. Mallory..... | 15 |
| A. J. Marshall..... | 15 |
| Charles Morgan | 15 |
| J. B. Morrel..... | 16 |
| Capt. Robert Parrott..... | 16 |
| James G. Patton..... | 16 |
| Lodner Phillips..... | 16 |
| Pascal Plant..... | 16 |
| Samuel M. Pook..... | 16 |
| John H. Porter..... | 16 |
| William Porter..... | 16 |
| Captain Pierce, CSA..... | 17 |
| Rochelle, Captain..... | 17 |
| Rufus Rhodes..... | 17 |
| Thomas J. Rodman..... | 17 |
| Thomas F. Rowland..... | 17 |
| Thomas Selfridge..... | 17 |
| Raphael Semmes..... | 17 |
| Edgar C. Singer..... | 17 |
| Slidell..... | 17 |
| Joseph Smith..... | 18 |
| Franklin Smithson..... | 18 |
| John Snowdon | 18 |
| Robert L. & Edwin A. Stevens..... | 18 |
| Alban C. Stimers..... | 18 |
| Nelson Tift..... | 18 |
| Theodore Timby..... | 19 |
| Brutus de Villeroi..... | 19 |
| John L. Worden..... | 19 |
| Baxter Watson..... | 19 |
| Ross Winans..... | 19 |
| Gideon Wells..... | 19 |
| Sir Joseph Whitworth..... | 19 |
| Charles G. Wilkinson..... | 20 |
| W. W. Wood..... | 20 |
| Urgency of Iron Clads for the Union..... | 20 |
| Urgency of Iron Clads for the Confederacy..... | 24 |

| | |
|--|----|
| Submarines..... | 27 |
| Riverine warfare | 31 |
| Ross Winans, Stonewall Jackson, and the Confederate Ironclad Neuse..... | 34 |
| Significance of the Monitor vs. the Virginia..... | 35 |
| The Guns..... | 36 |
| Dahlgren..... | 36 |
| Parrott..... | 37 |
| Columbiads | 37 |
| Rodman..... | 38 |
| Brookes Rifle..... | 38 |
| Whitworth..... | 39 |
| Sawyer Rifle..... | 39 |
| Selected Ironclads..... | 39 |
| Confederate States Ironclad Navy..... | 39 |
| CSS Arkansas..... | 40 |
| CSS Atlanta..... | 40 |
| CSS Cheops..... | 41 |
| CSS Fredericksburg..... | 42 |
| CSS Huntsville..... | 42 |
| CSS Jackson..... | 43 |
| CSS Louisiana..... | 43 |
| CSS Manassas..... | 44 |
| CSS Milledgeville | 44 |
| CSS Mississippi..... | 44 |
| CSS Missouri..... | 46 |
| CSS Mobile..... | 46 |
| CSS Neuse..... | 47 |
| CSS North Carolina..... | 47 |
| CSS Raleigh..... | 48 |
| CSS Richmond..... | 48 |
| CSS Stonewall..... | 49 |
| CSS Tennessee..... | 50 |
| CSS Texas..... | 51 |
| CSS Virginia..... | 51 |
| CSS Virginia- II..... | 53 |
| CSS Wilmington..... | 53 |

| | |
|----------------------------------|----|
| Union States Ironclad Navy..... | 54 |
| USS Atlanta | 54 |
| USS Benton..... | 54 |
| USS Cairo..... | 55 |
| USS Canonicus..... | 55 |
| USS Carondelet..... | 57 |
| USS Casco..... | 57 |
| USS Catawba | 58 |
| USS Catskill..... | 59 |
| USS Chimo | 59 |
| USS Chillicothe..... | 60 |
| USS Choctaw..... | 60 |
| USS Dictator..... | 61 |
| USS Dunderberg..... | 61 |
| USS Eastport..... | 61 |
| USS Essex..... | 62 |
| USS Galena..... | 63 |
| USS Indianola..... | 64 |
| USS Kalamazoo..... | 65 |
| USS Keokuk..... | 65 |
| USS Lexington..... | 67 |
| USS Marietta..... | 67 |
| USS Miantonomoh..... | 68 |
| USS Monitor..... | 69 |
| USS New Ironsides..... | 73 |
| USS Onondaga..... | 74 |
| USS Osage..... | 75 |
| USS Ozark..... | 76 |
| USS Passaic..... | 77 |
| USS Puritan..... | 78 |
| USS Queen City..... | 79 |
| USS Roanoak..... | 79 |
| USS Tecumseh..... | 80 |
| USS Tennessee..... | 81 |
| USS Vanderbilt..... | 81 |
| USS Winnebago..... | 81 |
| Structure and Organizations..... | 82 |

| | |
|--|----|
| The Mississippi River Squadron..... | 82 |
| Blocking Squadron..... | 83 |
| Potomac Flotilla..... | 84 |
| City class Ironclads..... | 84 |
| River Defense Fleet..... | 85 |
| James River Squadron..... | 87 |
| Western Gunboat Flotilla..... | 87 |
| Confederate River Defense Fleet..... | 87 |
| Mississippi Marine Brigade | 88 |
| United States Ram Fleet..... | 88 |
| Mississippi River Squadron..... | 88 |
| North & South Atlantic Blocking Squadron..... | 89 |
| Gulf Blocking Squadron..... | 89 |
| United States Ram Fleet..... | 89 |
| James River Squadron | 89 |
| Confederate River Defense Fleet | 90 |
| Campaigns and Expeditions..... | 90 |
| Charlestown Campaign..... | 90 |
| Red River Campaign..... | 91 |
| Yazoo Pass Expedition..... | 92 |
| Pacific Coast Theater..... | 92 |
| Shipyards and Facility's..... | 93 |
| Union shipyards..... | 93 |
| Baltimore..... | 93 |
| Boston..... | 93 |
| Brooklyn Navy Yard, New York..... | 94 |
| Cairo, IL..... | 94 |
| Cincinnati, OH..... | 94 |
| Louisville, KY..... | 94 |
| Mound City (IL) Naval Station..... | 95 |
| Mystic, Ct..... | 95 |
| New Albany, Indiana..... | 95 |
| Philadelphia Naval Shipyard..... | 95 |
| Pittsburgh..... | 95 |
| New York..... | 96 |
| Portsmouth Naval Shipyard..... | 96 |
| Vulcan Iron and Machine Works, Brownsville, PA | 96 |

| | |
|---|-----|
| Confederate shipyards | 99 |
| Bordeux, France..... | 99 |
| Memphis..... | 100 |
| New Orleans..... | 100 |
| Norfolk Naval Shipyard..... | 100 |
| Tredegar Iron Works, Richmond..... | 101 |
| Confederate Naval Works, Selma..... | 101 |
| Yazoo City, Mississippi..... | 101 |
| Wilmington, NC | 102 |
| Aircraft Carriers..... | 102 |
| Winans' Cigar ships..... | 102 |
| After the War..... | 106 |
| Technological significance..... | 106 |
| Where are they now?..... | 106 |
| Glossary of Terms..... | 109 |
| References..... | 112 |
| Resources..... | 117 |
| If you enjoyed this book, you might also enjoy one of my other books..... | 118 |

Introduction

This book is an overview of the Civil War ironclads that changed Naval Warfare forever. It focuses mainly on those ships designed and deployed on inland rivers.

The first ocean going, purpose-built iron clad was the French *Glorie* in 1859. Other maritime powers and wanna-be's quickly followed suite. The *Glorie's* design was influenced by the lessons-learned in the Crimean War. The British introduction of the iron hulled HMS *Warrior* changed the game again.

The day of the wooden ship, even updated with steam engines to replace sails, was coming to an end. The heavier cannon was prevailing over sturdy oak timbers. Offense was surging ahead of defense. Even in the Revolutionary war, wooden ships fell to hot-shot, cannon balls heated to red heat in a furnace. Steam, iron, and firepower were the new parameters of naval warfare.

The focus of this book is true ironclads, ignoring Gunboats and the Rams. We will mention the more lightly armored tin clads, and cotton clads. We will also talk about submarines. Gunboats, specifically for bombardment, not ship-ship combat, are not emphasized.

Another topic is that of Union and Confederate submarines. The most popular sub was the CSS *Hunley*, which sank a Union warship, but never returned to base. In fact, the North and the South produced and deployed dozens of different submarine designs.

There is a section near the end of this book showing where to see some of the surviving equipment.

At the beginning of the Civil War, it was obvious to the South that they were outgunned on the rivers, bays, and oceans. Confederate Secretary of State Mallory lead his country in a construction project of unprecedented size, scope, and cost. This was seen as a good idea after Lincoln ordered the blockade of southern ports

For more detail, I would recommend Tony Gibbons' *Warships and Naval Battles of the Civil War*, if you can find a copy. The go-to source for submarines of the period is Mark Ragan's *Union and Confederate Submarine Warfare in the Civil War*. Mark should know, he has his own submarine. See the References section of this book.

Dedicated to the brave men of both sides of the conflict, in the Army, Navy, and Marine Corps. They tested new fangled war machines that increased the efficiency of killing, at the cost of their own lives.

Author

The author is a native of Cumberland, Maryland. It is the site of the first armored train engagement of the Civil War, but no ironclad ships made it up the Potomac that far.

Background

In 1859, the French sea-going ironclad warship, *La Gloire*, was launched. It was literally a wood ship clad in iron. This caused much consternation in England, as a new arms race began. Their iron clad appears within a year. The HMS *Warrior* was then the most powerful warship in the world. Britannia rules the waves again. This was a Victorian paradigm shift that would result in the Dreadnoughts of World War One. A lot changed. The cotton industry that supplied sail-makers, had fewer customers. The Iron Clad's, and steam ships in general, needed coal for fuel. The more complicated iron ships needed field repair, since they sometimes couldn't get back to a dry dock. If a boiler needed replacement, the deck armor would need to be cut, and later repaired.

The ironclads were the super-weapons of their day, like the aircraft carrier, and nuclear submarines were later. Because this was new technology, no one was quite sure what to build and how to test. The Navy didn't know what it wanted, how to manage the projects, and how to evaluate the product. Hard lessons were learned in

battle. Cost overruns and schedule delays were the norm. Some things never change.

Who's who

This section discusses some of the men involved in the creation of the ironclads, the designers, the builders, the Naval personnel, and the captains and crew.

Joseph Reid Anderson

Anderson was the manager of the Tredegar Iron Works, in Richmond.

William Alexander

Alexander, in Mobile was from the UK, and corroborated with Hunley on his submarine project.

W. L. Barnes

Barnes was a Submarine builder of New York.

Judah P. Benjamin

Benjamin was the Confederate Secretary of War.

Col. George Bomford

Bomford served as the second Chief of Ordnance for the U. S. Army. He was a distinguished officer, designer, and inventor. He was responsible for the *Columbiads*, heavy coastal defense weapons.

John Mercer Brooke

Brooke was an officer in the Confederate States' Navy, and

designed a rifled coastal defense and Naval cannon. He was Flag officer of the James River Squadron, with the CSS *Virginia* as his flagship. He did not participate in the action against the *Monitor*.

Admiral Franklin Buchanan

Buchanan was the only full admiral in the Confederate Navy. He had previously served 45 years in the Union Navy.

At the Battle of Mobile Bay he was wounded and taken prisoner, but later, exchanged. No hard feelings, the U. S. Navy named three destroyers after him.

Cornelius Bushnell

Bushnell was a railroad tycoon and shipbuilder. He headed the New Haven and New London Railroad., which served Boston and New York. He was also involved in the submarine *Intelligent Whale* project.

Major General Benjamin F. Butler

Commander of the Army of the James. He was later relieved of his command by Grant.

W. M. Cheeney

Underwater explosives expert, with a submarine design in 1861. It was constructed at Tredegar.

Clive Clusler

Author, NUMA Chairman of the Board, bankrolled the recovery of the *Hunley*.

William Cramp

The William Cramp & Sons Shipyard in Philadelphia was the

subcontractor to Merrick & Sons, engine builders, for USS *New Ironsides*. The shipyard finally closed in 1947, having supplied ships and submarines to the Navy for 117 years.

John A. Dahlgren

Dahlgren was a big shot (sorry), who formed the Navy's Ordnance Department, and was responsible for significant advances in Naval gunnery. During the Civil War, he was Commander of the Washington Navy Yard. In 1863, he headed the South Atlantic Blocking Squadron.

Cornelius H. DeLamater

He was owner of the DeLameter Iron Works in New York City, and was a close friend of Ericson. The boilers and machinery of the USS *Monitor* were built there.

A. & W. Denmead

The father & son outfit from Baltimore had a foundry, where the light draft monitor Waxesaw was completed. The facility had built some 30 steam locomotives as well.

Lt. George E. Dixon

Commander of the submarine C. S. S. *Hunley* in action.

E. P. Doer

Sent a letter to the Navy Department about a submarine being designed and built in New Orleans, from information he got from a schoolteacher who was recently there.

James Buchanan Eads

Eads was a St. Louis Industrialist who ran the Missouri Wrecking Co. He made boats to remove stumps and obstructions from the

rivers, and used this format for an ironclad.

Samuel Eakins

Acting Master of the USS *Alligator* on her voyage to Port Royal, SC.

John Ericsson

John Ericsson, a Swedish-American, started out with a locomotive in the Rainhill Trials in England. He lost to George Stephenson. He designed the U. S. Navy's first screwed powered frigate, the USS *Princeton*. In a partnership with De Lamater, the first armored vessel with a rotating turret, the USS *Monitor* was built.

Admiral David Farragut

Farragut, born in New Orleans, was an Admiral in the United States Navy. At the beginning of the war, he was living in Norfolk, VA. He was responsible for the capture of New Orleans, and the Confederate port at Mobile Bay. He became a full Admiral in 1866, the first in the U.S. Navy, to finish out his 60 year career, which he started out as a midshipman at age 9.

Gustavus V. Fox

Fox was the assistant secretary of the Union Navy during the Civil War.

Frances H. Gregory

Read Admiral Gregory was the General Superintendent of Ironclads for the Union Navy.

John Halligern

Built the submarine CSS *St. Patrick*, which attacked the USS *Octorara*. The sub was damaged but not sunk.

Horstford, Professor

Invented a practical periscope, for a submarine design including airlocks. Material went to U.S. Navy Department for review.

Horace Hunley

Hunley, James McClintock, and Baxter Watson, built the first successful submarine that sank an enemy vessel in combat. The trio were involved in five submarine projects, as least.

Edward B. Hunt

Naval Captain at Brooklyn Naval Yard. He was killed in a test dive of a sub.

Benjamin F. Isherwood

Engineer-in Chief of the Union Navy.

Catesby ap Roger Jones

Originally an officer in the Union Navy, Jones was Commander of CSS *Virginia* in the action against the USS *Monitor*.

Julius Krorhl

Krorhl was the chief engineer with the Pacific Pearl Company. He submitted sub plans to the Union Navy, which didn't follow up. A later design in 1864 was built with his own funds. It eventually saw service in the bay of Panama, harvesting pearl oysters.

Private Charles P. Leavitt,

19 year old machinist, in the 2nd Virginia Infantry sent a letter to the Confederate Secretary of War, mentioning Winans' Cigar Ships, oxygen depletion, and carbon dioxide build-up. He was released from military service, and came to the Tredegar Works in

Richmond to work on subs.

John Lenthall

Lenthall was a naval architect and shipbuilder. He served at the Washington and the Philadelphia Naval yards. There is also evidence of a John Lenthall & Co. He became Chief Constructor of the Navy in 1849. In 1853, he became the head of the Navy's Bureau of Construction and Repair. The USS *Merrimack* was of his design. His USS *Roanoak* was converted into a triple turret ironclad monitor.

In the Civil war, he focused on ocean-going ships. He did design the *Miantonomah* class of riverine ironclads. He was responsible for the USS *Dundenberg*, the longest wooden ship ever built. It was an ocean-going casemate ironclad with 14 guns. She was bought by France after the war, renamed *Rochambeau*.

Corporal John Mackie,

Recipient of the Medal of Honor for actions on USS *Galena* at the battle of Drewry's Bluff. Sgt. Mackie, USMC was the first member of the Corps to receive the Medal.

Stephen R. Mallory

Mallory was the Confederate Secretary of State. He was previously the Democratic Senator from Florida, in the U. S. Senate. He was also Chairman of the Committee on Naval Affairs.

A. J. Marshall

Virginia Senator, owner of the Triton Company in Richmond.

Charles Morgan

Morgan Iron Works in New York City built marine steam engines.

J. B. Morrel

Morel was a New York submarine designer. He sent a letter to the War Department early in the Civil War, about the design and use of ironclads.

Capt. Robert Parrott

Captain of Ordnance for the Union Army. Resigned, and became the Superintendent of the West Point Iron and Cannon Foundry.

James G. Patton

Petersburg, Va. Built a submarine for the Confederate forces. A 10-inch model survives in private hands.

Lodner Phillips

Ex-shoemaker, submarine designer. Built and tested on Lake Michigan in 1850's, using buoyancy tanks and compressed air.

Pascal Plant

Inventor of the rocket powered torpedo, tested in the Potomac.

Samuel M. Pook

Naval Architect in Boston, Designed the City class of Ironclads, sometimes referred to as *Pook's Turtles*.

John H. Porter

Porter was the Confederate Chief Ironclad designer. He was responsible for the CSS *Virginia*, *Richmond*, and *Wilmington*.

William Porter

Commanding Officer of the 1,000 ton ironclad steamer USS *Essex*

Captain Pierce, CSA

Designer and builder of Submarine *Pierce*, operating in Mobile Bay to supply the City.

Rochelle, Captain.

French Navy officer, Inventor of the steam submarine *Plongeur*.

Rufus Rhodes

Confederate Commissioner of Patents.

Thomas J. Rodman

Rodman was a career Army Officer, designer and builder of the “strongest cast iron cannon ever made.”

Thomas F. Rowland

Proprietor of Roland's Continental Iron Works, Greenpoint, NY.

Thomas Selfridge

Commanded the *Alligator*.

Raphael Semmes

Admiral in the Confederate Navy, and brother to Samuel, who was active in the Management of the Mount Savage Iron Works in Western Maryland.

Edgar C. Singer

Underwater mine and torpedo expert, worked with Hunley.

Slidell

Confederate Commissioner to France, and brother of a U. S. Naval

Officer. He moved to Paris after the War, and died in England.

Joseph Smith

Commodore in the Union Navy, Chief of the Bureau of Yards and Docks.

Franklin Smithson

Smithson received Patent 61 from the Confederate States for a submarine. It was built, but sunk at Memphis during testing.

John Snowdon

John Snowdon was proprietor of the Vulcan Iron & Machine Works in Brownsville, PA. Snowdon had specialized in steam engines for Riverboats, but went on to build Ironclads in Pittsburgh.

Robert L. & Edwin A. Stevens

The brothers built the ironclad *Naugatuck*.

Alban C. Stimers

Chief Engineer Stimers was the Union General Inspector of Ironclads, and Chief Engineer of the Navy from 1862-64. He had served aboard USS *Merrimack*, the ship the Confederates turned into the CSS *Virginia*.

Nelson Tift

Colonel of Georgia Militia, member of the Georgia House of Representatives, Captain in the Confederate States Navy. Built Gunboats for the Navy.

Theodore Timby

Inventor of the revolving gun turret. It was used on the USS *Monitor*.

Brutus de Villeroi

French designer of the Union Submarine *Alligator*; 1862.. Built his first submarine in 1832, demonstrated in France. Unsuccessful in selling the concept to the French Navy, he came to the U. S. in 1856. He designed several submarines in Philadelphia.

John L. Worden

Lieutenant, U. S. Navy, Commander of the Monitor in the battle against the CSS Virginia.

Baxter Watson

Colleague of Hunley. May have built the CSS *Creole*.

Ross Winans

“Ingenuous Mechanic of Baltimore.” Inventor of the *Camel* locomotive, of which over a hundred were built for the B&O Railroad. Helped build the Czar's Railroad in Russia, between the Summer palace, and the Winter Palace. Possibly built a steam cannon for the Confederacy. Built a series of “Cigar ships.” Southern sympathizer, Memory of Maryland General Assembly.

Gideon Wells

United States Secretary of the Navy (SecNav) during the Civil War.

Sir Joseph Whitworth

Designed the British standard for screw threads. Developed the Whitworth Rifle, and also a large breech loading gun with a 2.75

inch bore. It could throw a 12 pound projectile 6 miles.

Charles G. Wilkinson

Killed in a submarine test dive in Savannah Harbor, due to a faulty valve.

W. W. Wood

Chief Naval Engineer of the Union.

Urgency of Iron Clads for the Union

The Monitor with guns in a revolving turret was thinking outside the box, by John Ericsson. A lot of material exists, and I will just give an overview, not paying justice to the man's genius.

The first iron warship of the United States was the USS *Michigan*. She served for 70 years on the Great Lakes. She was a side-wheel steamer, with sails. She was built in Pittsburgh, and actually served in the Civil War. There were rumors of a Confederate attack from Canada, that would seize the *Michigan*, and use her against shipping.

John Winslow, a partner of Erasmus Corning, worked at the Albany and the Rensselaer Iron Works in New York in 1837. He was an engineer, iron master, the inventor of compound rail, and President of the Mount Savage Iron Company in Western Maryland in 1848. He traveled extensively in Europe in 1852, buying the rights to iron and steel processes. In 1861, he partnered with John Ericsson on his Navy contract to build an iron clad war ship, the *Monitor*. Some of the techniques he developed for making hardened iron plate may have come from his work at Mount Savage in the period 1848-1852.

Ericsson had built railroad locomotives, and the screw power steam frigate USS *Princeton*. The monitor was built at the De Lamater Iron Works in New York. It was the first armored ship

with a rotating turret. He had presented a proposal in 1854 for armored battle ships to Napoleon-III, but nothing came of it. France built its first ocean going Monitor, the *Glorie*, in 1859. This kicked off another arms race with the British.

Ericsson's design for the Monitor had a rotating turret with dual canon. It had a design evolved from Swedish lumber rafts. Not much showed above the water line except the turret. Not many people were impressed, but he got the contract to build one. It went from drawings to launch in 100 days. It missed getting to Hampton Roads to protect the two Union vessels the CSS *Virginia* sank, the the USS *Cumberland*, and USS *Congress*. Then, in the very first battle between ironclad war ships, of strikingly different design, They fought to a stalemate. The rotating gun turret is now a standard feature of modern warships. Ericsson used laminated armor plate. The Monitor's hull was built by Continental Iron Works, Thomas F. Rowland; and the machinery by the Delamater Iron Works of New York City, on West 13th Street, at the Hudson.

When Ericsson died in 1889, he had expressed a wish to be buried in his native Sweden. The US Navy took his body home on the USS *Baltimore*, escorted by two other warships. A twenty-one gun salute was given as his body was offloaded.

When the news of the construction of the CSS *Virginia* reached Washington, an advisory group called the Ironclad board was established. It consisted of several high-ranking naval officers, and the Assistant Secretary of the Navy, none of whom had experience with ironclad ships. They were chosen by Secretary of the Navy, Gideon Welles. They had received seventeen proposals for ironclad ships. It was decided to choose three, and have prototypes built. One of these became the USS *Galena*. A second design came from Erickson, but it was rejected. The third design was a fully rigged ship with wrought side armor. The board was driven by urgency. The *Virginia* was seen as capable of ascending the Potomac, and bombarding Washington. Another issue was shallow draft riverine boats as well as ocean-going ones. Don't worry, it was decided by

committee.

The second iron clad built by the North was the USS *Galena*, a wooden hulled frigate with iron rail armor. She was schooner-rigged corvette. Two and one-half inches of armor plate was backed with 1.5 inches of rubber. Later, the rubber was removed and replaced with 5/8 inches of additional iron. Around the same time, the number of masts was reduced from 3 to 2. She participated in the Battle of Drewry's Bluff, near Richmond, along with the *Monitor*. In a shoot-out with shore battery's, she was hit some 44 time, 13 of which penetrated the armor, killing 13 and wounding 11.

She was repaired and refitted in Philadelphia, and got back in time to participate in the battle of Mobile Bay, with the West Gulf Blocking Squadron. She was tasked to sink the CSS *Tennessee*, which she failed to do. After the war, she went to Portsmouth, NH, and was decommissioned in 1869. She was broken up in 1872.

As the iron clad revolution got started, a whole new infrastructure was needed. Generally, the Navy built its own wooden ships. Now, it didn't have the technology or expertise. The work was contracted out to industry. They had never built an iron clad either. They needed plans and specifications, but there were none. Ericsson was the sole source, and he was busy building ironclads. The traditional ship builders did not have skill with iron. They mostly subcontracted work to iron facilities, who needed detailed drawings. The first problem was to specify exacting what was needed. This took the Navy a while to master. Industry could procure steam engines and armor plate, but needed to know how to put it all together, correctly, and in the right order. There were only two places in the country that had built ironclads, so an industry had to be developed from scratch. Key players included Gustavus Fox, Assist. Secretary of the Navy, Alban C. Stimers, Chief Engineer of the Navy, General Inspector of Ironclads, and inventor John Ericsson, who was the initial source of design information. It was a fast changing technology, as the focus shifted to iron boats.

At the end of each encounter with the enemy an after-action report detailed what went right, and what needed to be change. This affected the iron boats in construction. And they all needed detailed drawings by a draftsman, who were in short supply. All labor was in short supply due to the war, and skilled craftsmen were being drafted. Industrial mobilization on a national scale was implemented. A monitor such as the USS *Tippecanoe* required 254 man-years of labor.

Ironclad production depended on armor plate production, steam engine production, and the large guns. Those specialty products were limited by raw materials, coal, and skilled workers as well.

The years before the war saw 8,000 new vessels built, all wooden. 1,600 of these were constructed in the South. The south at least had a large supply of wood, but a limited supply of iron, and the facilities to produce iron product. Pennsylvania had more specialty iron works than the entire South. In 1860, only the Tredegar Works in Richmond could cast big guns. Even delivery was a problem. Iron plate for the *Virginia* was delayed by railroad traffic. The railroad network was inadequate. The North and South had the same manpower problem, as skilled workmen were drafted. The Army and the Navy were at odds over personnel. Large amounts of coal were needed to build and operate the ships. The North had an interesting problem, as cotton supplies from the south were cut off, and sails, tents, backpacks, gun covers, etc. were in short supply. As the author has confirmed, cotton does not grow north of the Potomac River.

This scenario would be duplicated later in NASA's lunar missions, and beyond. Their approach of cheaper, better, faster resulted in larger, more expensive, and more complex systems. In many ways, Ericsson and von Braun were in the same class, good engineering managers. Similar analogies can be seen with the bomber aircraft and submarine production in World War-2.

Fox had been sent to relieve Fort Sumpter, but he arrived too late.

He was instrumental in getting contractors all across the Northern states to build and test what was needed. Simmers had been working with Ericsson on the *Monitor*, so he was one of the few with hands-on experience.

At the start of the war, the U. S. Navy had ten ship yards, two were in the South, Norfolk and Pensacola. The Industrialized North had private companies that could supply ships fittings, boilers, cannon, and armor plate.

Urgency of Iron Clads for the Confederacy

The Confederate Navy needed a new super-weapon to cut the Union's blockade stranglehold. The Southern States did not have the resources and manufacturing capability of the North. Later, the South's focus would shift to breaking the blockade of Cities like Memphis, Charleston, and New Orleans.

The South did have some good engineers. The CSS *Virginia* was less revolutionary than the *Monitor*. It worked fine in their engagement, generally considered a draw. It certainly got the Union Navy's attention. The *Virginia* attacked USS *Congress*. After trading cannon rounds, the *Congress* surrendered. As the sailors were being evacuated, the *Virginia* came under fire from a shore battery. She retaliated by firing hot shot into the *Congress*, and setting her on fire.

There was damage to the *Virginia*. Besides a broken ram, the port anchor was lost. The shore batteries had damaged her smokestack, affecting the draft of the boilers. Two cannon were damaged, and some armor plate had been loosened. The Captain had been wounded by rifle fire from shore. He ordered the *Virginia* to attack the USS *Minnesota*, a wooden steam frigate which had run aground after fleeing the scene.

The *Monitor* arrived that night, in the nick of time. The legendary battle the next day came to a draw. The *Monitor* was agile, but the *Virginia* had a lot more guns. Both designs would be used subsequently.

The next day, the *Virginia* returned to port, as the pilots noted that they had to get over a sandbar at high tide.

Cotton-clads were steam powered, and of wooden construction. They participated in the Battles of Memphis and Galveston. They were deployed to ram the enemy ships. Examples include the CSS *Governor Moore*, a side-wheeler, the CSS *Stonewall Jackson*, also a paddle wheeler.

Today armor is typically steel or a composite, but during the time of the Civil War, it was iron. The trick is not just to prevent shell penetration, but also to not have the armor shatter due to impact. Steel is iron with just the right amount of carbon. It had been made in small batches since around 500 BC. Production of steel took off after the Civil War, by the 1870's.

More armor gives more protection, but also adds more weight. Iron clads are low in the water, providing more protection from shot, but are also more prone to take on water, and sink. Positioning the armor at a slant, like on the C.S.S. *Virginia* will deflect enemy shells. An armored belt extending below the waterline protects against ramming, and torpedoes.

The development of explosive shells mostly made the wooden Navy's obsolete. A transition was made to iron hulls, but the key was armoring the sides and deck as well.

One big problem with armor that is strong enough to protect against penetration is that it spalls, or sends off pieces from the back of the armor into the occupied space, when hit especially hard. This can occur with large solid shot, and also high explosive rounds.

The USRC *Naugatuck* was a Union ironclad with twin propellers, That eliminated the need to protect the side or stern paddle wheels. The first use of a propeller on ships was in 1839. The *Naugatuck* was proposed to the U. S. Navy Department, and construction was approved by Congress in 1842. In 1842, the U. S. Navy had 42 total vessels, spread from New York to Japan. The *Naugatuck* was constructed by Robert L. and Edwin A. Stevens. This was an

outgrowth of a threat of war with England over the Canadian border. The war of 1812 showed the vulnerability of the new country to a major Naval Power. Problems with the design and construction lead to a cancellation of the contract, and the nearly-completed propeller-driven ironclad sat out the war in a drydock in Hoboken, NJ. It was dubbed the *Stevens Battery*. It was a casemate design, intended as a fast, mobile, floating battery. The original design was for a 350 foot long ship of 1,500 tons. There would be six large caliber cannon in casemates. There were to be 4.5 inches of iron plate, backed by fourteen inches of wood. The ship would have been able to partially submerge, lowering its profile and target area.

Construction was delayed into 1854 for a variety of reasons. By then, the project had expanded in scope, size, weight, armament, and armor. It was to have eight boilers to allow two propellers to drive her at 20 knots. Shaft driven fans were included for crew comfort. Some progress was made, but one of the brothers died in 1855, and work stopped for three years. The Navy was losing interest, and Congress had spent a half-million dollars on the project. It was estimated that another three quarters of a million would be needed to launch the ship, not completely outfitted.

In 1862, there were at least 15 bidders for the Navy's ironclads. These included Harland & Hollingsworth in Delaware; Harrison, in St. Louis; Stack and Secor & Co. in New York; Geifse & McCoy in Wellsville, Ohio; Miles Greenwood in Cincinnati; G. C. Bester in Peoria; Snowdon & Mason in Pittsburgh; The Atlantic Works of Boston; Harrison & Loring in Boston; The Pennsylvania Iron Works in Chester; Wilcox & Whiting of New Jersey; Petrine in NY; and the Niles Works and Ashcroft in Cincinnati.

Another ship was built for the U. S. Revenue Service to evaluate, the USS *Naugatuck*, incorporating many of the original design features. Her main gun burst in 1862. The Navy lost interest in the project, and the ship was never completed.

Other approaches were timber-clad, and tin-clad. None of these

approaches worked well. The timber-clads had additional wooden planking on the sides. Examples are the *Conestoga*, the *Essex*, the *Lexington*, and the *Tyler*. The *Conestoga* was developed from a civilian side-wheel towboat, built in Brownsville, PA. She participated in the expedition up the Tennessee River, and on the Mississippi, under the command of the Army. At the time, the Army was responsible for waterways in the Interior of the Country. She was transferred to the Navy in 1862, and served in Arkansas, Tennessee, and Louisiana. She was sunk as a result of a collision with the USS *General Price*, due to a mis-interpretation of whistle signals.

The tin-clads, referring to lightly armored vehicles, operated with the Mississippi Squadron, and on the Tennessee, Cumberland, and Ohio Rivers.

A wooden merchant ship built in Cincinnati was acquired by the Navy, and commissioned at the USS *Victory*. It was steam powered. And used as a gunboat, for convey escort, reconnaissance, and for delivering dispatches. She was decommissioned in 1865, and sold.

But the rural South, lacking raw materials, shipyards, and shipwrights, still managed to construct 34 ironclads. Of these 25 went into service. The South managed to get the first ironclad, the CSS *Virginia*, built from the USS *Merrimack* in 1862, at the former U.S. Navy shipyard at Hampton Roads. This ship could navigate up the Chesapeake bay to the Potomac, and bombard Washington. There was great concern.

Submarines

The South managed to deploy submarines, the best known being the CSS *Hunley*. It was the first combat submarine to engage and sink a warship, the ill-fated USS *Housatonic*. The *Hunley* was seen to exchange signals with the shore after the *Housatonic* sank. It never reached shore, though. *Hunley* was under Army control. At the time of the attack, all Union warships had anti-submarine nets

employed. The *Hunley* use a Singer torpedo. The *Housatonic* sank in 3 minutes, with a loss of only 5 men. *Housatonic* had been alerted, and was at battle stations.

The *Hunley* crew all lost their lives after in the attack. Thirteen men had died on the *Hunley* before the action against the *Housatonic*. It was actually the third time the craft sank. The two sinkings did not involve enemy action, and the craft was recovered. The *Hunley* was 40 feet long, built in 1863 of a steam boiler, in Mobile, Alabama. The inventor, Horace Hunley lost his life on one of the test-run sinkings.

The *Hunley* was in Vicksburg in July of 1863, tied up at the Theater Street dock. Harbor trials were conducted. McClintock was the Chief designer.

The South had at least three private submarine projects, bankrolled by Horace Lawson Hunley, James McClintock, and Baxter Watson. The Confederacy had offered a \$100,000 prize to anyone who would destroyed an Ironclad, and \$50,000 for every Monitor sunk.

William Cheeney developed a submarine before the *Hunley*, name unknown. It was the first to conduct a combat mission in the summer of 1861. This was observed by a Union spy, Mrs. Baker, who reported to Union Spy Chief Pinkerton. She also reported a second boat in work at Tredegar. This news drove the development of anti-submarine nets for the Navy. Those worked, as evidenced by the thwarted attack on the USS *Minnesota* in October of 1862.

This sub used a float on the surface to provide air to the crew. Lookouts were advised to check on this, and indeed, three weeks later, foiled another sub attack.

The *Pioneer*, also by Hunley, was abandoned as Union troops approached New Orleans. It saw no action, but was scuttled in the New Basin Canal, and later raised by Union troops. She had a contemporary, the *Bayou St. John* submarine. *Pioneer* was reportedly sold for scrap in 1868. The *Bayou St. John* submarine

was recovered, and is in a museum. There is a possibility it was actually the *Pioneer* that was recovered. The details of the recovered sub are, 20 feet long, 3 feet in width, 6 feet high, and with a hand-cranked propeller.

The *Hunley* crew were also involved in a second sub at Memphis, it was 36 feet long, 3 feet wide, and 4 feet high. They experimented with “electromagnetic propulsion,” an early electric motor and battery arrangement..

Both the USS *Alligator* and the CSS *Pioneer-II* were lost at sea, sunk in a gale, location unknown. The *Pioneer-II* is thought to lie in Mobile Bay. It was a 5-man sub, launched in January 1863.

The American Submarine Company was formed by Augustus Price and Cornelius Bushnell in 1864. Bushnell was a railroad executive and shipbuilder before the war. He was involved in some ironclad construction. The design of the *Whale* was by Scovel Sturgis Merriam. It was to have a crew of thirteen. Its first trial didn't come until 1872 and was unsuccessful. The boat survived, and is on display in Sea Girt City, NJ.

The majority of the 266 Confederate patents issued during the war were lost in a fire. There is a list of patents issued up to 1865 at:

<https://web.archive.org/web/20090205013014/http://www.myoutbox.net/popchapx.htm>

A search through the list for “submarine” shows seven results.

These include the names of James C. Patton of Petersburg, J. G. Wire of New Orleans, C. Williams of St. Louis, and J. Nichols and J. Bennett of Memphis. Not further information was uncovered.

The USS *Alligator* was being built in Philadelphia in 1861, the Navy's first submarine. She was preceded in the Revolutionary War by Bushnell's *Turtle*, which was not successful. The *Alligator* was the design of a French Engineer, Brutus Villeroi. He served as a supervisor of construction during the early phase. It was built by

the firm of Neafie & Levy, a Philadelphia shipbuilding firm. The ship was 30 feet long, and about 6 feet in diameter. It was divided into watertight compartments internally. It carried a crew of 18. She was originally built with 16 hand-powered paddles, but was later retrofitted at the Washington Navy Yard with a hand cranked propeller. She had two floats to supply breathing air to the crew, operated by pumps, and it had an air purifying apparatus. There was an airlock, so crew could leave and return to the ship while it was submerged. This would allow the attachment of an electrically operated mine to enemy vessels. She was supposed to be completed in 40 days, an ambitious schedule, but took 180. It was launched in May of 1862. She went to the Navy Yard to be fitted out, and was commissioned into the service.

In dive tests in the Potomac, she almost sank. It was found that a crew of 18 could not maintain headway, let alone progress against the tidal current, near the Navy Yard. Her primary mission of destroying the *Virginia-II* was seen as non-feasible

Because the water were not deep enough for her to dive completely, she went back to the Navy Yard in Washington for more testing. The test did not work out well. She was observed by President Lincoln. She next went under tow to Port Royal, SC, to participate in the capture of Charleston. In bad weather, she was set adrift with no crew, and her final location is unknown. NOAA is leading the hunt.

Union Subs were built and tested at Newark, New York, and Philadelphia, and Confederate subs at Hampton Roads, New Orleans, and Mobile Bay. The American Submarine Company of Newark, New Jersey, built a boat, but it was not finished until 1 year after the war ended. Subs were used at the Siege of Mobile to ferry supplies to the City.

In New Orleans, Baxter Watson and James McClintock were working on the submarine *Pioneer*. It had a 30 foot long hull, made of 1/2" iron plate. It was tested in the New Basin Canal, some 3 days after the Monitor:Virginia clash at Norfolk. Horace Hunley was also involved, and the trio developed three submarines with

their own funds. The sub had an operational depth gauge, using a tube of mercury. It's skipper, John K. Scott, had a Letter of Marque from the Confederacy, to attack and capture Union ships. Unfortunately, the sub wasn't ready until the time that New Orleans fell to Union troops. It was scuttled in the basin, but recovered by U. S. troops. It was reportedly sold for scrap.

The Gentlemen, now organized as the Singer Submarine Corps, relocated to Mobile, Alabama, and began work at the Paris & Lyons Machine shop on the next sub, the *American Diver*. It used an existing 48" boiler shell as a hull. Singer and underwater mine and torpedo expert, was working with them

There were reports of a pair of subs built at the Tredegar works in Richmond.

It is known that on June 24, 1862 opposing naval forces at Norfolk each had a submarine. The Confederate one built at Tredegar, and the Union Alligator.

The Confederacy also had twenty torpedo boats, resembling submarines, common to the first unit, the *David*. These were semi-submersible, hard to see, and used a spar torpedo to sink ships. They could be lowered by taking in water to interior tanks, that could later be pumped out. It had two floats to supply breathing air to the crew, operated by pumps, and it had an air purifying apparatus. There was an airlock, so crew could leave and return to the ship while it was submerged. This would allow the attachment of an electrically operated mine to enemy vessels. It was supposed to be completed in 40 days, an ambitious schedule, but took 180. It was launched in May of 1862. She went to Philadelphia to be fitted out, and was commissioned into the service. She proceeded to Hampton Roads, in tow. A side wheel steamer was assigned as her tender.

Riverine warfare

Many of the Ironclads were built at inland locations, on rivers. The big Naval facilities along the coast, New York, the Naval Yard in

DC, and Newport News in Virginia, were busy with Ocean-going ships. Most of the early ironclads were not seaworthy, and were built along rivers, mostly the Mississippi, and its tributaries.

River Monitors were primarily of the *Neosho* and *Marietta* class. There were also Harbor, Coastal, and Seagoing Monitors.

Maneuverability is a key feature of water navigation, as is the draft of the vessel.

Inland rivers froze; there was low water at certain time. There was a need for ships that could navigate the rivers to deliver and support troops. New facilities were needed to produce a series of shallow-draft ironclads. The river system of the Mississippi was a good choice. The major waterways of contention between the Union and the Confederacy included the Mississippi, and its tributaries.

The armored gunboats were part of the brown water navy, serving the muddy waters of the Mississippi and its tributaries. The ironclads used were of shallow draft and laid low in the water. They would not be able to operate in the open ocean, as was demonstrated when the USS *Monitor* went down off Cape Hatteras.

In many cases, a receding water level would trap some of the ships upstream, and the U. S. Army Corps of engineers had to get creative with dams to raise the upstream water level.

One such battle, in the Ohio River between West Virginia and Ohio was called the battle of Buffington Island. It was the largest battle in Ohio during the war. It saw the USS *Brilliant*, *Fairplay*, *Moose*, *Reindeer*, *St. Clair*, *Silver Lake*, *Springfield*, *Victory*, *Naumkeag*, and *Queen City* in action.

Brilliant was a steamer built in Brownsville, Pa and bought by the War Department in 1862. She served on the Ohio, Cumberland, Mississippi, and Tennessee Rivers during the war.

Fairplay was built in Indiana in 1859. It started out in the Confederate Navy, but was captured by the 76th Ohio Volunteer Infantry. She was one of the *City*-class ironclads (named after Cities). There were seven vessels of uniform design built in Carondelet, Missouri, shipyards owned by James Buchanan Eads. Eads was a wealthy St. Louis industrialist who risked his fortune in support of the Union. Their case mate armor was 2.5 inches thick plate, 13 inches wide, and 8 to 13 feet long. The armor plate weighed more than 75 tons. The armor protected the engines and the forward case mate. After the Battle of Fort Pillow, an additional 47 tons of armor was installed, including railroad iron at stems and sterns for defense against ramming.

The *City*-class vessels were also called *Eads* gunboats, after the industrialist, or *Pooks Turtles*, after a Navy designer, and referred to the overall shape of the vessel. They were casemate gunboats. Generally, Union casemate ironclads were not built to be seaworthy, and were used only in riverine operations. Confederate case mate ironclads were generally seaworthy, at least close to the shore.

There was a 22 foot paddle wheel, driven by two steam engines. These were supplied by five boilers. The steam cylinders had a 22 inch cylinder, and a six foot stroke.

The armament consisted of 13 guns, three forward, four on each side, and two facing back. The vessels started out with six 32-pounders, three 8 inch Dahlgren smoothbores, and four 43 pounder rifled cannon. In addition, some had a 12-pounder howitzer to engage land targets.

The Tin-clads, lightly armored, formed the amphibious division, with 4-6 jon boats for landing infantry.

The *Casco*-class monitors were light draft ships, of which twenty were built. They proved to be expensive and unseaworthy. There was a lot of bureaucratic meddling by Congress in their design and

construction, which was done by Ericsson. A lot of “improvements” were attempted, which stretched schedules and complicated construction. Better is the enemy of good. All were sold for scrap after the end of the war.

USS *Waxsaw* was a single turret, twin-screw ironclad, built in Baltimore, MD, by A. & W. Denmead & Son. She was launched in May of 1865. She was of the *Casco* class. She was laid up after delivery at the Philadelphia Navy Yard, and broken up in New York in 1875.

The USS *Tippecanoe* was an example of a *Canoncius* class monitor. There were twelve of eventually these built, and were around to see action in the Spanish-American war. Four were built on the Ohio River during the Civil War. Production had been shifted from the seacoast to the inland waterways to allow more facilities units to build boats.

Ross Winans, Stonewall Jackson, and the Confederate Ironclad Neuse

Colonel Thomas (“Stonewall”) Jackson of the Virginia State Militia was tasked with organizing the defense of Harper’s Ferry, VA in April 1861. He realized the location was for all practical purposes indefensible. But there was a lot of equipment and supplies the Confederacy could use.

Harper's Ferry is on the rail line from Baltimore to Cumberland, and is on the southern bank of the Potomac River. The C&O Canal from Washington, D.C. is on the Northern bank. The Shenandoah River joins the Potomac at Harper's Ferry.

Some of the captured rail assets could move via the Winchester & Potomac Railroad 30 miles to Winchester. That line, though, was lightly-built. Jackson's goal was the Manassas Gap Railway at Strasburg. After the spoils of war were removed and Harper’s

Ferry abandoned, Col. Jackson moved to Martinsburg, VA to appropriate some 42 locomotives, over 300 cars, and shops machinery. What couldn't be moved, was burned. From Martinsburg, the valuable locomotives needed to move south, but there was no convenient rail line. Artillery officers knew how to move heavy equipment – forty horse teams hauled the locomotives and cars down the Valley Turnpike from Martinsburg through Winchester to Strasburg.

B&O locomotive 34, a Winans Mud-digger locomotive named *Gladiator*. It was built in November of 1844, and had 17" x 24" cylinders, with 33 inch wheels. It weighed 47,000 pounds. *Gladiator* was damaged while in Confederate hands, during a Union cavalry raid. The boiler from the unit was used in the construction of the Confederate ironclad ram C.S.S. *Neuse*.

Significance of the Monitor vs. the Virginia

Although the battle was a draw, the significance of the event was Earth shaking. The end of wooden warships had come about. The Age of steam was phasing in to replace sail. More importantly, Naval fleets and vessels were changing from sail to steam. This was a paradigm shift of massive importance. If the Stevens Brothers had gotten their ship finished, this would have happened earlier. The Monitor and the Virginia were examples of two approaches to armored ships, turret and casemate. Like the battle between them, the outcome was a draw. Both designs had their good and bad points, but both worked.

What if, we ask. What if Ericsson hadn't started on his Monitor project. Would the Virginia had sailed up the Chesapeake Bay, and the Potomac River to shell Washington, and the Navy Yard? Would the Union have sought peace? Would we still be a divided country?

The Guns

This section describes the armament of the iron clads, and the Navy in general. Both smooth bore and rifled cannon were used. Rifled cannon were more accurate, but harder to produce. Firing from the turret of a rolling ship is a lot harder than from on land. The Bureau of Ordnance was in charge of gun procurement.

Dahlgren

A design of Union Rear Admiral John A. Dahlgren, the big Dahlgren guns were used by both the army and the navy. They came in various bores. Aware of the failure of earlier designs, he sought a better design using science. They bulged out at the breech to add more material. They looked like, and were often referred to as “soda bottles.”

Dahlgren started his career building smooth bore muzzle loading howitzers. These were used in the Mexican-American war to support landing parties. The Dahlgrens were cast in bronze, and did not have trunnions. The smoothbores fired solid shot, shrapnel, and canister. The rifled units fired solid shot and shell. Percussion primers were used by the Navy, but Army friction primers could also be used.

The heavy 12-pounder was preferred by the infantry, with the 24 pounder boat howitzer for gunboats. At the First Battle of Bull Run, the Union forces left behind two boat howitzers, that the Confederate forces snatched. They became the favorite of both sides in the conflict. The boat howitzers went up to a 24 pounder (which refers to the weight of the shell).

The U. S. Navy followed the experience of the French Navy in replacing smooth bore cannon guns firing explosive shells. They kept the ability to fire solid shells, against armored targets. An interesting statistic is that no Dahlgren gun burst in service.

Models of the Dahlgren gun included a 32-pounder, a nine-inch, and a 10-inch. The heavy 10-inch gun had a crew of 20.

There was also an 11-inch, a 13-inch, and a 15 inch, which came in a short version for Monitors. There were also 15 and 20 inch coastal defense guns.

Dahlgren started out making guns the way everybody else did – by casting them solid and boring them out. Fellow gun maker Rodman had developed a technique where the gun was cast around a pipe, which was later removed. Dahlgren also made rifled guns, up to a twelve inch model.

Dahlgren guns were cast at many foundry's, including Alger Builders (Providence, Rhode Island), Fort Pitt Foundry (Pittsburg, and Seyfert, McManus & Co. (Boston), Bellona Arsenal (east of Richmond), Tredegar (Confederate) Foundry (Richmond), and West Point Foundry (New York).

Parrott

Parrott rifles were invented by Captain Robert Parrott, a graduate of the West Point Military Academy. When he left military service, he became the head of the West Point Foundry. He patented his work in 1861. The guns were made of cast iron, with a reinforcing band of wrought iron shrunk on at the breech. Over the years, they were made by both combatants in the civil war, and in sizes from 10 pounders to a 300 pounder. The designation refers to the weight of the shell.

The Union Navy made use of 20, 60, and 100 pounders. The larger ones were used in coastal defense. Unfortunately, the guns had a bad reputation for safety.

Columbiads

The Columbiad design came from Colonel George Bomford of the Union Army. It was used extensively in seacoast defense. It was first used in the War of 1812. Their downside was their expense. The Rodman gun, discussed below, was an improvement on the Columbiads. They were produced in 8-, 10, 12-, and 20-inch

diameters. The 20-incher weighed 60 tons, and could throw its projectile some 5 miles. The Confederate Columbiads were captured from Federal stores.

Rodman

Thomas J. Rodman, an Ordnance Corps officer, came up with his design before the Civil war. They were distinctive in their soda-bottle shape. He also defined the “Rodman Process” which involving cooling the casting from the inside out. Production started in 1858, and continued throughout the war, at various foundries. There were 8, 10, 15 and 20 inch Rodman guns, the number referring to the bore diameter. The 15 inch round weighed 400 pounds, and the 20 inch could throw its shells more than 5 miles. The Confederates used Rodman guns, from captured Federal armory's. They also produced their own 8 and 10 inch, but did not know about the Rodman Process. Many of their guns failed.

Brookes Rifle

The design of the Brooks Rifle is due to John Mercer Brookes, an officer of the Confederate States navy. They featured a band of wrought iron shrunk around the breech. The barrels were cast iron. No foundry in the south could shrink a single band around the gun, so they used a series of small bands. The guns used a 7 groove rifling with a right hand twist. In Richmond, these were built at the Tredegar Iron Works, and the Selma Naval Ordnance Works. They were bored at the Richmond Naval Ordnance Works after a fire at the Tredegar facility.

They came in 6.4 inch, 7 inch, and 8-inch sizes. Two of the seven inch was mounted fore and aft on the CSS *Virginia*. One of the 7 inch variety served on the CSS *Richmond*.

Brooke also made smoothbores in 6.4 inch, 7 inch, 8 inch sizes

Brookes designed his own ammunition, in armor piercing and

explosive types. The armor piercing rounds were a solid cylinder with a blunt front. The explosive type was a hollow sphere, filled with gun powder. Four of the guns were captured by the U. S. Navy on a blockade runner in January of 1862, and two sent to bombard Fort Sumter.

Whitworth

The Whitworth Naval gun was designed by the Baronet Sir Joseph Whitworth. It had a distinctive hexagonal rifled design. The shell was hexagonal as well. Whitworth went on to supply a larger version, a 120 pounder, for the Brazilian Navy.

Sawyer Rifle

Sylvanus Sawyer was an inventor from Massachusetts. He was responsible for the Secretary of War declaring that rifled projectiles were practical for war. Only a few of the Sawyers were used in the ironclad Navy.

Selected Ironclads

This section is not comprehensive, but tries to give an overview of the various classes of iron clads. There were variations within classes, and lessons-learned from engagements that were implemented on later ships.

Confederate States Ironclad Navy

This section discusses the iron clads of the Confederate Navy. The best known is the *CSS Virginia*, nee *USS Merrimack*. I have not included purpose-built armored rams, but sometimes an armored iron clad also had a ram. Gotta draw a line somewhere.

The first ironclad steamer in the United States to enter was the *CSS Manassa*, used against Union warships on the Mississippi, in October 1861.

CSS Arkansas

The *Arkansas* was built in Memphis. Before that City fell, she was moved down to the Yazoo River to prevent capture. She was basically just a hull at this point. There, local craftsmen and soldiers were able to finish her construction. She was a dual screw ironclad ram with a casemate.

She carried two 8 inch, 64 pounder cannon; two 32 pounder rifled cannon, dual 100-pound Columbiads, and two six inch naval guns.

Five weeks later, as the river level was falling, she was ordered to Vicksburg. About 15 miles along, a steam leak was discovered which leaked into the forward magazine, and wet the gunpowder. The crew laid it out in the sun on tarps, and it was dry enough by sundown to reload and proceed. She got into an engagement with the Union vessels *Carondelet*, *Tyler*, and *Queen of the West*. She disabled the *Carondelet*, and ran past the Union blockade (which did not have its steam up) and got to Vicksburg.

She forced the Northern Navy to keep steam up, 24 x 7. A shot from the USS *Essex* penetrated the armor, and killed six. She was rammed by *Queen of the West*, without loss of life, or serious damage. Eventually, lacking the cooperation of the Army, Admiral Farragut moved the fleet back to near New Orleans. In spite of needing repairs, the *Arkansas* went down the river to Baton Rouge. The engines broke down several times during the trip.

An engagement with the *Essex* again ended badly, as both engines' crank pins failed at the same time. She was abandoned and set on fire. She drifted downstream and blew up. The location of the debris is near a levee at Baton Rouge.

CSS Atlanta

The *Atlanta* was a casement ironclad. She had been a Scottish blockade runner, the *Fingal*, purchased by the Confederacy. She made one run, carrying military supplies. She was converted to a warship in Savannah. She was a dual masted iron ship, one

hundred and eighty feet long with a 25 foot beam. There were two steam engines, fed by a single boiler, allowing for a speed of twelve knots.

Her armor was railroad iron in two layers, one vertical, one horizontal, backed by three inches of oak. There were eight gun ports in the casemate, two forward, three on each side. She had 7-inch pivoting Brookes rifles fore and aft. They weighed around seven and a half tons, and threw a 110 pound shell, or a lighter armor piercing round. On the sides, the middle gun was a 6.4 inch Brooke. She had a 20 foot spar as a ram, that was fitted with explosives.

A major design deficiency was lack of adequate ventilation belowdecks.

Coming out of Savannah, she had to face the Union gunboat, *Isondiga*. She managed to get herself grounded on a sandbar. She was hit and holed by a 15 inch shell, and heavily damaged by two more shots. She was forced to surrender.

She was re-armed with dual 8 inch guns, 150 pound Parrott rifles fore and aft. She spent the rest of the war with the Union Navy, serving on the James River as part of the North Atlantic Blocking Squadron. Her name was not changed, as this was considered to bring bad luck to a vessel.

She eventually was sold to the Navy of Haiti for use during their Civil War, but was sunk in a storm with a loss of all hands during delivery.

CSS Cheops

The *Cheops*, and a sister ship *Stonewall*, were built in France for the Confederate Navy in 1864. The French Government blocked the sale, under pressure from the U.S., and she was subsequently sold to Prussia.

CSS Fredericksburg

The *Fredericksburg* was built at Richmond. She went down to Drewry's Bluff on the James for fitting out, and getting her armament. She was assigned to the James River Squadron.

She had an altercation with the USS *Onondaga* June of 1864, of which nothing of note happened. She was blown up by Confederate Forces, as Richmond was evacuated in April of 1865. The area is called the *Lost Confederate Fleet*. NUMA located the site from archived records, and sonar scans. It is near Drewry's Bluff, site of a major engagement. Looking through the Army Corps of Engineer's archives, a researcher found a document, "Position of Wrecks, Drewry's Bluff." The map dates to 1865, and outlines the locations of 8 ships. NUMA Chairman and author Clive Custler found a detailed map of Drewry's Bluff, dating from 1881. It had detailed locations of the ships. An underwater magnetic gradiometer was used to search for magnetic anomalies on the bottom. Three major ones were found

The *Virginia-II* was located under 20 feet of silt. The CSS *Fredericksburg* is upriver from the Virginia, some 15 feet under the mud. The *Northampton*, a side-wheel steamer cargo ship was deliberately sunk as an obstruction. The *Jamestown* was a passenger steamer converted to a gunboat. She fought alongside the *Virginia*, and was sunk in the middle of the river as an obstruction. These ships were of the James River Squadron. The Confederates also sank the steamers *Jamestown*, *Northampton*, and *Curtis Peck* as obstructions.

CSS Huntsville

The CSS *Huntsville* was ordered in 1862, and completed at the Confederate Naval Works at Selma early in 1863. She was delivered for action in August. The iron plate came from the Shelby Iron Works, and the Atlanta Rolling Mill. Her engines came from a river steamer, and never worked well. Her armament

was incomplete.

In the Battle of Mobile Bay, which went bad for the Confederates, *Huntsville* escaped up the Spanish River. She and another ship, the CSS *Tuscaloosa*, were scuttled when the City fell. The location of the ship is known.

CSS Jackson

This ship was built in Cincinnati in 1849, as the *Yankee*. She was a side wheel river tug. She was purchased in New Orleans in 1861, and fitted out for Naval service. She went up the Mississippi to join her sister ships in a squadron. She and shore batteries engaged the USS *Lexington* and USS *Tyler*. In a later engagement, an 8 inch shell to the wheel house put her out of the action, with only one engine working.

She went, as part of Hollins' Squadron, to attack blockade ships at the Head of Passes, where the Mississippi mouth is located. Not effective against the Naval forces of the Union, she went to New Orleans, and was destroyed by Confederate forces when the City fell.

CSS Louisiana

This ship was a casement style ironclad, laid down in New Orleans in 1861. The ship leaked a lot, probably to the lack of seasoned lumber. They were in a hurry to get her into action.

The casemate was 200 feet long, and sloped at 45 degrees. It had two layers of railroad iron.

The ship was driven by two protected paddle wheels in the center as well as dual screw propellers. She displaced 1400 tons. She carried dual 7 inch rifled cannon, three 9 inch, and four 8-inch, and seven thirty-two pounders.

She turned out to be a bit overwhelmed by the Mississippi current. During Porter's siege of the City, nearly all of the Confederate Defense fleet was destroyed. When the forts protecting the City

surrendered, the ship was set on fire, and adrift. It is not recorded what its final disposal was.

CSS Manassas

The *Manassas* started her working lifetime in 1855 as a steam ice breaker for service in Massachusetts, the *Enoch Train*. She was captured by a privateer, and sold in New Orleans. She was armed and fitted out at Algiers, LA. She was then brought into the Confederate Navy.

She was a radically modern ironclad ram, with a single gun behind an armored shutter at the bow.

1.25 inch iron plating was added, and she had a distinctive turtleback above the water line. She was 128 feet long, with an 11 foot draft. Union Intelligence described her as “a hellish machine.”

At the mouth of the Mississippi, she rammed USS *Richmond*, but lost her iron ram, and the impact loosened one of her engines. She was heavily shelled, but the armor held. She saw heavy action as Farragut's fleet entered the river from the Gulf, heading for New Orleans.

In later action, she was grounded and set on fire, after she exploded. The Captain reported no casualties.

CSS Milledgeville

The *Milledgeville* was a shallow draft iron clad that did not get to see action. She was of the caisson type, with 8 guns, 175 feet long, 35 feet wide, and drawing 9 feet of water. She was in construction at the facilities of H. F. Willink in the Savannah, and was launched just in time for the City to fall to the Union troops. She was sunk to prevent capture.

CSS Mississippi

CSS *Mississippi* was not yet completed at New Orleans when the

City fell to Federal troops. she did have an interesting design, and was built according to standard house building techniques. The reason for this may have been the lack of shipwrights and a surplus of carpenters in the city. As the Federal troops entered the city, the unfinished ships were launched and burned.

The ship was to have sixteen guns, and triple propellers. It would have flat sides and square corners – like a house. Stephen Mallory, the Confederate Secretary of State, liked the idea, and passed it on to a Navy review board, who approved it. There was no available shipyard in New Orleans, so the principal, Nelson Tift, and his brother (a friend of Mallory) established one on the north side, at Jefferson City.

Construction started in October of 1861. The planned length was extended to accommodate more boilers, so two additional guns could be carried.

Iron plate for armor was scarce in the Confederacy, and transportation was almost non-existent. A foundry in Atlanta was to supply the plate. It arrived after the ship had been scuttled and burned.

There were three engines, but not enough room to put them side by side. One was moved forward, but the lengthened shaft required could not be built anywhere in the Confederacy. A shaft from a wrecked ship was found that would do the job, but it had to be modified either by the Tredegar Works in Richmond, or the Gosport Navy Yard.. The three shafts made it to the ship and were put into place. There were not, as yet, connected to the engines. Incredibly, the labor force called a strike. Tift gave in. At the same time, the military insisted that all men not in the military, even those on critical projects, had to participate in the militia. The Union was aware of the construction, and speeded up the timetable to take New Orleans before they could be completed.

Before the ships were completed, they were floated, although nowhere near finished. Then Admiral Farragut's fleet arrived, and all was lost.

CSS Missouri

The *Missouri* was a paddle steamer, built with 8-port casemates. She was 183 feet long, with railroad iron armor nailed to a backing of 23 inches of yellow pine. The armor extended 6 feet below the water line, as a defense against rams. There was a 22 foot long, 8 foot wide center paddle wheel aft, mostly protected by the casemate. The center position of the paddle wheel made the ship hard to steer. There were two steam engines, fed by four boilers. She could achieve a blazing 6 mph.

Unfortunately, the yellow pine that was used was not seasoned. The chinks were caulked with cotton (use what you have), and she was said to “...leak like a sieve...”

There was an eleven inch gun at the front, that covered ahead and to starboard. A 32-pounder fired ahead and to port. There were 9 inch guns along the sides. The guns were salvaged from the captured USS *Harriet Lane*. She had been a revenue cutter, pressed into Navy service, and then captured by the Confederate Navy in 1863. Interestingly, she was recaptured by Union Forces at the end of the war, declared unfit for service, and abandoned at sea.

Missouri served on the Red River, most of the time trapped in Shreveport. She was stuck there by low river levels. By March 1865, the river level was sufficient to get the boat out into the water. Unfortunately, she then surrendered to Union Forces, as the last Confederate to surrender. They had her armor and guns removed, and she was sold at Public auction.

CSS Mobile

After the fall of New Orleans, the Confederacy was in dire straights. The Mississippi was completely open to Northern navigation. A wooden sidewheel boat with four guns was the CSS *Mobile*. She went to Yazoo City (Mississippi) to be armored. There was also construction at the site for a large sidewheel ironclad. The armor was delayed, due to lack of available railroad delivery, locomotives, and rolling stock. With Union troops heading up the

Yazoo, the boats were burned.

CSS Neuse

The ironclad was built on the banks of the Neuse River in North Carolina by the Confederate shipbuilders Thomas Howard and Elijah Ellis, to a design by John L. Porter. She had generally the same design as the C. S. S. *Albemarle* but with four additional gun ports. The hull measured 158 feet long by 34 feet wide, and had an 8-sided armored casemate with 10 guns. The ship was constructed of pine with oak backing for 4-inches of wrought iron armor. The casemate had two 6.4 inch Brooke rifled cannon on pivot carriages. Each gun weighed 12,000 lbs. These were located on the centerline, fore and aft. The pivot allowed a 180 degree field of fire. This ship was launched in November of 1863, fitted out, and steamed up in April 1864 with the sturdy, re-purposed Winans steam boiler. She promptly grounded in mud, due to her weight, and possibly since she was crewed with Army personnel. She stayed near the Town of Kingston, NC as a floating gun battery. During the siege of Kingston in March, she was sunk by scuttling charges placed by her crew. After the war, the hulk was salvaged for all its valuable parts: cannon, armor, engine. What was left stayed submerged for the next 100 years. She was raised in 1963, and this resulted in the recovery of some 15,000 shipboard artifacts. The recovered lower hull is on display, and a full-scale replica with full interior details is also on display in Kinston, NC.

Winans, who had Southern, or, at least, States-rights sympathies, would have agreed with the reuse of his Baltimore-built locomotive boiler to defend against the troops of Union General Sherman.

CSS North Carolina

The *North Carolina* was a casemate style ironclad, built by the firm Berry & Brothers at Wilmington, North Carolina. She was commissioned in late 1863. The casemate was angled at 30

degrees, and was overlaid with four inches of railroad iron. She had dual gun ports on each of the four sides of the casemate, protected by shutters. These had six 8-inch cannon on wheeled carriages. There was a large rifled gun on a pivot at the bow.

CSS Raleigh

Sister ship to the North Carolina, the *Raleigh* didn't fare too well. She was found unsuitable for use on the ocean, and the hull had a bad infestation of ship worms due to the use of non-cured, non-treated lumber. She foundered in the Cape Fear River. Her cannon, armor, and steam engines were salvaged.

CSS Richmond

The *Richmond* was an ironclad ram, built at Gosport Navy Yard. It was designed by William Graves. In 1862, she could float at least, and was towed to Richmond as Federal forces had taken the Navy Yard. She was finished and outfitted there. She was commissioned in 1862, and served in the James River Squadron.

The ship had 22 inches of yellow pine and oak overlaid with 4 inches of iron. The armor extended 3 ½ feet below the water line. She was 172 feet long, with a 34 foot beam. She had four rifled guns, 2 shell guns, and could mount a spar torpedo. Each side of the casemate had three gunports, with shutters. She carried 150 officers and crew. There were two steam engines. She was usually accompanied by her tender and resupply ship *Drewry*. The *Drewry* was hit by two 100 pound shells at the battle at Trent's Reach, and exploded.

Richmond engaged in many actions with the James River Squadron. At one point she was caught under fire with the *Virginia*, while aground at Trent's Reach. Luckily, the grounded ships were at an angle that allowed Union shot to ricochet. They escaped, but *Richmond* had to be destroyed a few weeks later to avoid capture. She is part of the *Lost Confederate Fleet*.

CSS Stonewall

The *Stonewall* had a most interesting career. She was built in Bordeaux, France, for the Confederate States Navy in 1864, and sailed across the Atlantic. She was captured by the United States Navy, and eventually sold to Japan, as their first ironclad. For the Japanese, she fought in several decisive naval battles.

She resulted from a conversation between Slidell, the Confederate commissioner to France, and Napoleon-III. That was illegal under French Law, but Napoleon agreed. Two ships were built, the *Stonewall*, originally code-named *Sphynx* and *Cheops* to suggest they were for the Egyptian Navy. The guns were British.

The United States got wind of the situation, and complained to France. Under pressure from the U.S. Government, the sale to the Confederacy was cancelled. The ships were later sold to Denmark and Prussia, who were currently at war. It gets better.

The ship that was to become *Stonewall* was crewed by a Confederate Navy contingent in Copenhagen. This North was aware of this, and tried to intercept the ship before it reached the States. The trans-Atlantic voyage was interrupted as the ship began to leak, and put in at Lisbon for repairs. For there, she sailed to Nassau and Havana, reaching there only to learn the war was over. The ship was sold to Spanish authorities, and, in turn, to the U. S. Navy.

She was then sold to Japan, delivery involving the treacherous voyage around the tip of South American. She may have been the most sea-worthy iron clad ever. She initially still carried the American flag upon arrival in Japan, due to an ongoing war in which the U. S. was officially neutral. She was delivered to the Japanese government in 1869. She immediately went into action against the Japanese rebels as the *Adzuma*.

She had been equipped with a Gatling gun, to repel boarders. She had a long and interesting career with the Japanese, and was in service until 1888.

Stonewall was 194 feet long, and 31 feet wide. The armor was 4.5 inches thick on the sides, and 3.5 inches on the bow and stern. There was 24 inches of wood backing behind the armor. She carried a crew of 135.

She had two steam-driven propellers. She had a 9 inch 300 pounder cannon forward, and a pair of 70 pounders aft in a fixed turret.

CSS Tennessee

The *Tennessee* was a casemate style ironclad, which served as the flagship of the Mobile Squadron, under Admiral Buchanan. She was built at Selma, Alabama, and fitted out in Mobile. Her armor was triple thickness, from the Shelby Iron Company.

She was built in Baltimore, and, at the start of the war, was in New Orleans. She was seized and became the CSS Tennessee.

In the battle of Mobile Bay the ship could not ram the Union ironclads due to their superior speed. She did conduct a vigorous fire upon them. She was rammed by several Federal vessels, and lost her steering chains. Eventually, she was forced to surrender.

She was put back into Union service as USS *Tennessee*, and participated in the Siege of Fort Morgan.

After the war, she went back into civilian service as the USS Republic, as passenger ship on the New York to New Orleans run. In October of 1865, she was caught in a hurricane off the Georgia coast. She sank, with the passengers and crew in lifeboats. She supposedly had \$400,000 in coin aboard.

She was located in 2003 by the Odyssey Marine Exploration company. She's about 100 miles South East of Savannah in 1,700 feet of water. About one third of the gold was recovered, worth an estimated \$75 million.

CSS Texas

The *Texas* was a casemate iron clad of the *Columbia* class. Construction began in 1864, and she joined the James River Squadron. She saw no action, and was captured while being fitted out. She was being constructed at Rockett's Naval Yard in Richmond. When the City was evacuated, the Confederate forces did not have time to damage or destroy her. Three tugboats towed her to the Norfolk Navy Shipyard, and her engines and armor were taken from a warehouse. She was tested afloat, but never saw action. She was sold at auction.

The *Columbia* class had a distinctive octagonal casemate. *Texas* was the recipient of upgrades and changes, based on lessons learned in battle. She was 217 feet long, 48 feet across the beam, and drew 13 feet of water. There were two engines, driving propellers, supplied with steam from dual boilers.

A model of the *Texas* was built for a movie based on Clive Custer's novel *Sahara*.

CSS Virginia

The *Virginia* was built at the Gosport Navy Yard (now, Norfolk Navy Yard) in Portsmouth, Virginia. Expecting a Confederate takeover, the Yard was emptied, ships burned, and the dry-dock damaged. The USS *Merrimack* had been burned to the waterline. It was salvaged, and its hull and machinery were undamaged. It was rebuilt as a casemate ironclad. The planking of the casemate was 24 inches of oak with two inches of iron plating. The side walls of the casemate were inclined at 35 degrees. The Confederates followed the progress of the construction of the *Monitor* in the New York Times. It was said the *Times* reached Richmond before it reached Washington, D. C.

The *Merrimack* had been built in 1855 at the Boston Navy Yard as a steam frigate. She was 275 feet long, 38 feet wide, and had a draft of 24 feet. She could get up to 12 knots. She was commissioned in 1856, and tasked as the flagship of the Pacific

Squadron.

Virginia was not very fast or maneuverable. The steam engines had been scheduled for replacement. She was not agile, taking about 45 minutes to complete a full circle. A casemate ironclad such as the *Virginia* has to maneuver the entire ship to bring the guns to bear, as opposed to the revolving turret of the USS *Monitor*. When the troubles broke out, SecNav ordered her to Philadelphia. The rebels had sunk boats in the channel to prevent ships from leaving. She was burned to the waterline to prevent capture.

Rebuilt, she had 14 gun ports. Armament included 4 muzzle-loading Brooke rifles and six smooth bore 9 inch Dahlgrens. The bow and stern guns were 7 inch, firing a more than 100 lb shell. There were also 6.4 inch cannon. The amidships Dahlgrens, near the furnaces, could fire heated shot. These were devastating to wooden ships, mostly useless against armor. Two howitzers on the upper casemate could be used to prevent boarding.

Not having a strong iron industry, the Confederacy typically used railroad rails as armor, as apposed to flat cast plate.

First action for the *Virginia* went fairly well, and a paradigm shift in Navel warfare happened quickly. She engaged and badly damaged the USS *Cumberland* with cannon fire, and rammed her. The *Virginia's* ram broke off, causing a leak.. The nearby Union frigate USS *Congress* went into shallow water, and grounded. It was some protection, since the *Virginia's* weight gave a 22 foot draft.

As Union troops took Norfolk, the *Virginia* had gone up the James River to protect Richmond. The consensus was she was not seaworthy. Her deep draft prevented her from going very far. Her cannon were removed, and went to Drewry's Bluff.

The *Virginia* was abandoned, and set ablaze, after the encounter with the *Monitor*. Only a few artifacts have been recovered, but her battle ensign went to the Chicago History Museum.

CSS Virginia- II

CSS *Virginia-II* was a steam powered ironclad, intended as a ram. She was built in Richmond. Some corners were cut; there was not enough iron plating, and the casemate was shortened, allowing for fewer cannon to be installed. She carried an 11 inch smoothbore, an 8 inch rifle, and a pair of 6.4 inch rifles.

She was mostly built with funds from the *Ladies Aid and Defense Society* of Richmond. She took a year longer than planned to be buidt, and wasn't fitted out until May of 1864. She served as flagship of the James River Squadron.

In an action at Trent's Reach, a chain from a nearby warship fouled her propeller. She was hit by Federal fire at the action at Dutch Gap. She was hit by seven 100 pound shots which only managed to dent her armor somewhat. In an action against the dual turret USS *Onodaga*, her armor was pierced.

Heavily damaged, she went in for repair. But she and other members of the squadron were ordered destroyed by Admiral Semmes. After the war, a lot of the ships were salvaged.

CSS Wilmington

The *Wilmington* was designed by John Porter. His father was a shipwright at Portsmouth, and he became a civilian employee for the Navy. When the war came, he resigned from the Union Navy, and worked for the Confederate Navy at Gosport. He had experience in transforming the USS *Merrimack* into the CSS *Virginia*. He moved on to be a Naval Constructor at Wilmington, NC.

The *Wilmington* was 224 feet wide, 42 feet across the beam, and drew more than nine feet of water. It had two guns in two casemates. Although they could be muscled around to fire from one of the three ports. There were two engines, turning 8 foot diameter screws. The engines were supplied with steam from four boilers. The ship never made it to the water, but was destroyed

when the City fell.

Union States Ironclad Navy

Early in the war, the Union Navy had directed that 20 light draft ironclads be built for use on the inland waterways. This section discusses some of those.

USS Atlanta

see CSS Atlanta.

USS Benton

Named after a Senator, *Benton* was a center-well catamaran snagboat. Her job was going to be hoisting tree stumps and such out of navigable rivers, and raise sunken steamboats. She was converted into a warship at St. Louis. She joined the Army's Western Gunboat Flotilla, and a member of the City-class fleet.

She had originally been named *Submarine Number 7*, although it was desirable to keep her on the surface. It was built by the James Eads' Missouri Wrecking Company.

She started out with dual 9-inch smoothbore cannons, seven 42-pounder rifles, and seven 32-pounder rifles. Her ordnance changed multiple times, as she was up-gunned.

In 1862, she participated in the Battle of Island Number 10, and the Kentucky Bend on the Mississippi, and the Battle of Plum Point Bend. She saw action in the Battle of Memphis. The rest of her year was fairly tame, as she patrolled the Yazoo River.

She saw action again in 1863, when she led a column of 11 vessels past the defenses of Vicksburg at night. She was hit five times, one of the rounds split her casemate. She was in the lead of a seven ironclad fleet in a bombardment of Grand Gulf. She took a round that pierced the armor and killed 25 crewmen. She returned to Vicksburg, and continued to bombard the City until it came into Union hands.

In 1864, she lead a fleet up the Red River to Shreveport. She and the rest of the fleet were eventually stranded by dropping water levels, and multiple dams were build to raise the water level enough to get them out. Her last act in active service was to go up the Red River to take the surrender of the CSS *Missouri*. She was decommissioned in 1865 at Mound City, Iowa. Armor and guns removed, she was sold for scrap.

USS Cairo

Cairo was the first of the City-class gunboats. She was of a casemate design, built at Mound City, Illinois. She was responsible for the capture of the Confederate Fort Pillow on the Mississippi, allowing the capture of Memphis. She was part of the Yazoo Pass Expedition, but sunk while clearing mines at Haines Bluff. She had the dubious distinction of being the first ship to be sunk by a remotely detonated mine. She was a member of the Army's Western Gunboat Flotilla, seeing action at Clarksville and Nashville, TN, and at Fort Pillow. She participated in the Yazoo Pass Expedition.

She originally had three 8 inch smoothbores, six 42-pounders, six 32-pounders, and a 12-pounder rifle. As with most of the boats, the guns were update during her active service.

Unlike most gunboats of the war, she was located from Civil War era maps by an employee of the Vicksburg National Military park. Artifacts were recovered, and the gun boat was eventually salvaged, although in three sections. She went to the Ingalls shipyard in Pascagoula, where the armor was removed, and the engines were refurbished. She is listed on the National Register of Historic Places, and is on display in the Vicksburg National Military ark

USS Canonicus

The *Canonicus* was a single turret monitor. She was 234 feet long, with a 43 foot beam, and a draft of 13 ½ feet. Her tonnage was

1,034. She had a dual cylinder horizontal steam engine, with two horizontal fire tube boilers. The engines drove a single propeller. The configuration produced 320 horsepower, which produced a peak speed of eight knots. She was named for a chief of the Narragansett Indians.

The main armament was dual smooth bore 15-inch Dahlgren guns in a single turret. Each gun weighed in at 22 tons. They were capable of lofting a 350 pound shell to 2,100 yards.

For armor, there were five layers of wrought iron plate, backed by wood. On the turret and pilot house, there were ten inches of armor. Wrought iron is not the ideal armor, as it is brittle, and subject to shattering when hit with some high speed heavy object. The deck armor was 1.5 inches thick. Based on lessons learned from the First Battle of Charleston Harbor, the turret had a 5 inch by 15 inch soft iron band installed, to keep shell fragments from jamming the turret. The turret also had a rifle screen at the top. Another update was that armor plates were riveted together, not bolted.

The ship was built in Boston, and commissioned in April of 1864. She then sailed to Newport News, and joined the James River Flotilla. She supported Butler's Army of the James. She exchanged fire with Confederate shore batteries, and was hit several times, with minor damage.

She then was assigned to the North Atlantic Blocking Squadron at Beauford, NC. She was involved in the attack against Fort Fisher in December of 1864. She was hit four times, with minor damage. In the same area in January of '65 she was hit 38 times, with light damage. Her flag was shot away twice, and replaced under fire by Quartermaster Stevens, for which action he received the Medal of Honor.

She was then sent to the South Atlantic Blocking Squadron at Charleston. She captured a blockade runner that had been stranded.

She and several other ships went to Havana, Cuba, to search for the CSS *Stonewall*, only to find it had been surrendered to Spanish authorities. She became the first American iron clad to visit a foreign port. She returned to the Philadelphia Naval Yard, and was decommissioned. She was recommissioned in 1872, and served in the coastal water of the eastern seaboard, and the Gulf. She was decommissioned a second time at Pensacola, and towed to Hampton Roads. She was a star of the 1907 Jamestown Exposition, then sold for scrap.

USS Carondelet

This was the first ironclad warship commissioned by the U. S. Navy in January of 1862. It defined the *City* class of ironclads. Riverine ironclads were owned by the Army, although they had Navy enlisted personnel and officers.

It was a casemate gunboat, built by James Eads of St. Louis, at the Union Iron Works in Carondelet, Mississippi. She was commissioned in January of 1862, and joined the Western Gunboat Flotilla. She engaged with CSS *Arkansas*, was heavily damaged, and lost 35 of the crew.

Repaired, she maintained vigil off of Vicksburg. She also sailed with the Red River Expedition, and patrolled the Cumberland River. She was decommissioned at Mound City IL in June of 1865.

Awaiting scrapping, she broke her moorings and the flood water took her some 130 miles down the Ohio. The wreckage was found there by NUMA, just a few days after a dredge went over the site, spreading most the the debris.

USS Casco

Casco was the first in a new class of twenty light monitors for the Atlantic Works in Boston. She was launched in 1864, but judged unseaworthy. Her turret and guns were removed, and she was converted to carry a spar torpedo. John Ericsson, of Monitor fame,

designed the *Casco*. But the drawings were modified by the General Inspector of Ironclads, Stimers. Ericsson had not been shown the changes. In the wake of the failed attack on Charlestown, lessons-learned forced other design changes. Stimmers continued to make unauthorized changes, and the final design would have resulted in a freeboard of three inches. By June of 1864, Stimmers was no longer in control of the project, and Ericsson was put in charge. He had to have the hulls of the Monitors in construction reduced by two feet. The completed vessels had to have their turrets removed, and a pivot mount 11-inch Dahlgren gun emplaced.

Ready to fight, *Casco* was towed to the James River at Hampton Roads. She came back to serve with the Potomac Flotilla, and was decommissioned at the Washington Navy Yard. She was finally broken up in 1875.

USS Catawba

Catawba was the first Cincinnati-built ironclad, and the first built west of the Alleghenies. She featured a single turret. She was 225 feet long with a beam of 43 feet, and draft of 13 feet, 6 inches. Her tonnage was 1034. She was named after the Catawba River in North Carolina. Her builders were Alexander Smith & Company.

She had a dual cylinder horizontal steam engine, driving a single propeller. Steam was supplied by dual horizontal boilers. The rated power was 320 horsepower, providing a performance of 8 knots.

The armor was 5 inches of wrought iron plate. The turret had 10 inches of plate, and the deck armor was 1.5 inches. She had the updated band at the base of the turret to prevent jamming, as well as the turret top rifle screen. The funnel was protected by 8 inches of armor to a height above the deck of eight feet.

The main armament was dual 15-inch Dahlgren guns. They could lob a 350 pound shell more than 2,000 yards.

She couldn't get out of Cincinnati for fitting out due to low water levels on the Ohio. She and some sister ships were moved opposite Cairo, IL in June 1865. She entered service in April, 1865, and anchored in the center of the main channel. This was not ideal, so they were again moved, this time to New Orleans in May of '66.

She wasn't completed until after the end of the war, and then sold back to her builders. They, in turn, sold her to the Government of Peru for \$375,000. Now known as the *Atahualpa*, after the last Emperor of the Incan Empire, she served in the Pacific (which implies a successful transit of the Horn). To prevent capture by Chilean troops, she was scuttled, later refloated, and scrapped.

USS Catskill

Catskill was a Passaic class ironclad, single turret. Ships of the *Passaic* design were later used in the Spanish-American war, in 1898. It was, essentially, an enhanced *Monitor*, taking advantage of lessons-learned from operations and combat.

The *Passaic* class mounted a 15 inch Dahlgren gun, in place of the Monitor's 11 inch one. The *Passaic* ships were larger, and had the pilot house relocated to the top of the turret. The boats also had better ventilation

The interior of the armored turret was 21 feet in diameter, making it a tight squeeze for the big Dahlgren.

USS Chimo

The *Chimo*, a light draft monitor, was built by Aquila Adams & Co, South Boston. She was commissioned in January, 1865. She was of the *Casco* class of monitors. That meant less armor for a shallow draft. In addition, like modern submarines, they had a ballast tank and pumps, so she could be lowered in the water. Of a proposed 20 ships of this design, only eight were completed before the end of the war. *Chimo* left Boston for New York, then on to

Hampton Roads, and duty at Point Lookout, North Caroline. She returned to the Washington Navy Yard in June of 1865, and was decommissioned.

USS Chillicothe

Chillicothe was built in Cincinnati, and commissioned into the Navy in September of 1862 at Jefferson, Indiana. She had to wait for the water levels to rise, which delayed her deployment until January of 1863. This was the downside of boatyards on the upper rivers.

She spent her entire career in the Mississippi. She went on the White River Expedition in Arkansas, participating in the capture of Fort Hindman. She was part of the Yazoo Pass Operation, where she was heavily damaged and suffered casualties. She was repaired at Mound City, IL and returned to duty in September of 1863.

She was part of the Red River Expedition. It was here that her commanding officer was killed by rifle fire. For a year, '64-'65 she lay off of Fort Adams, MS. She went to Cairo, IL, in July of 1865, and was later decommissioned and sold at auction. She did not have good luck as a civilian, and was lost in a fire in 1872.

USS Choctaw

Choctaw started out as a thousand ton side wheel merchant steamer, but joined the Navy for the war. She was converted to an armored gunboat and ram. She had been built in Indiana in 1853. She was purchased by the Army, and then commissioned into the Navy in 1863.

She spent all of her time on the Mississippi river system. She went up the Yazoo, and was hit by shells more than 50 times. She supported attacks by Federal Troops who burned Confederate facilities at Haynes Bluff, and also a yard and ships at Yazoo City. She participated in the action that resulted in the capture of Fort DeRussy.

She was decommissioned at the end of the war in Louisiana, and sold at auction in New Orleans.

USS Dictator

The *Dictator* was a single turret ironclad that was seaworthy. She was designed for speed, but only achieved about 10 knots. She served with the North Atlantic Blocking Squadron. She was decommissioned in 1877. She had been built by the Delameter Iron Works in New York, under contract with Ericcson. She was commissioned in 1864.

She was out of commission from September 1865 to 1869, when she was recommissioned, and served with the North Atlantic Fleet until 1871. She was again decommissioned in 1877, and finally sold in 1883.

The ship was 312 feet long, 50 feet wide, and had a draft of 20 feet. She displaced 4,500 tons. She had dual cylinder Ericcson steam engines, generating 3,500 horsepower to drive two screws. For armament, she carried two 15 inch Dahlgren smoothbores. For defense, she carried 15 inches of armor on the turret. The pilothouse was protected by twelve inches of iron. There were 6 inches on the hull, and 1.5 inches on the deck.

USS Dunderberg

The *Dunderberg* began construction in 1862, but was not ready by the end of the war. She was put up for sale, and Prussia expressed an interest in buying her. This alarmed France enough to purchase her, and commission the ship as *Rochambeau*. She participated in the Franco-Prussian War in 1870 and was scrapped in 1874.

USS Eastport

The *Eastport* had been captured from the Confederates, and served with the Union Navy as a convoy escort. She was partially completed on the Tennessee River. She was upgraded at Cairo, IL.

She served in the Mississippi and White River. When the Western Flotilla was turned over from the Army to the Navy, she became a part of the Mississippi Squadron. She was heading to Vicksburg, but grounded, and was sent back to Cairo for repairs.

She went down to the mouth of the Red River, and went to Fort De Russy. After that Fort was taken, she headed up river. In April, she hit a mine, and was damaged. She couldn't be salvaged, and had to be blown up to prevent capture. A ton and a half of powder did the trick.

USS Essex

The *Essex* was an ironclad river gunboat, built in 1856 as a steam ferry. It was built at New Albany, Indiana. She joined the Western Gunboat Flotilla, and was modified as a timber-clad casemate-design gunboat. She was later updated with iron armor. At the attack on Fort Henry, TN, she was badly damaged.

The *Essex* was a 1,000 ton gunboat. It was part of the U.S. Army's Western Gunboat Flotilla. In 1862, she was badly damaged due to Confederate gunfire. After upgrades and repairs, she took part in the battle of Vicksburg, engaging the CSS *Arkansas*. She was transferred to the Navy, and served until the war's end. She was decommissioned in 1865, and sold, but scrapped in 1870.

The Commanding officer, William Porter, made modifications to his boat, on his own initiative. She was made longer, wider, and re-engineered. She got new engines, and was up-armoured.

She engaged the CSS *Arkansas* near Vicksburg, with no definitive results. She then joined Farragut's Squadron, and was, for a time, the only Union ironclad on the lower Mississippi. She was in on the attack on Baton Rouge, and engaged the *Arkansas* again. The *Arkansas*' steering jammed, and the crew had to abandon her.

Essex was officially transferred from the Army to the Navy in 1862. She was present at the bombardment of Port Hudson, the occupation of Baton Rouge, the capture of Fort Hudson, and the

Red River Campaign. By December of 1864, she was in Memphis. She was decommissioned in 1865, and sold. In civilian garb, she was the *New Era*, scrapped in 1870.

USS Galena

Galena was a wooden hulled ironclad, serving in the North Atlantic Blocking Squadron, in the Peninsula Campaign. She had been damaged during the Battle of Drewry's Bluff, because of insufficient armor. She was hit 44 times on the port side, 13 of which penetrated the armor. She had received three large holes in her spar deck. She suffered thirteen killed and eleven wounded. In that action, two of her sailors and one Marine received the Medal of Honor. Corporal John Mackie, USMC, was the first Marine to receive that honor. When most of the Naval gun crew was killed or wounded, Mackie and his Marines took over operation of the guns. He also received an advancement in rank.

The citation is,

“On board the U.S.S. Galena, in the attack on Fort Darling, at Drewry's Bluff, James River, on May 15, 1862. As enemy shellfire raked the deck of his ship, Corporal Mackie fearlessly maintained his musket fire against the rifle pits along the shore and, when ordered to fill vacancies at guns caused by men wounded and killed in action, manned the weapon with skill and courage.”

Semper Fi, Sgt. Mackie.

Galena was rebuilt, and assigned to the West Gulf Blocking Squadron. She saw action in the Battle of Mobile Bay and the Siege of Fort Morgan. Damaged, she went to the Philadelphia Navy Yard for repairs. She then rejoined the North Atlantic Blocking Squadron at Hampton Roads. Surviving the war, she was decommissioned at Portsmouth. She went to Hampton roads, and was scrapped.

Galerna's original design was a schooner-rigged, 3-mast corvette.

She had wrought-iron armor plates, backed with rubber. She was 210 feet long, with a beam of 36 feet, and a draft of 11 feet. She hosted a crew of 150.

She was modified by having the rubber behind the armor replaced by additional iron plate, but there was a concern over the additional weight. Eventually, she would up with 2 inches of plate.

Galena had a single steam engine, feed by dual boilers, and driving a propeller. She achieved 8 knots.

She had dual 100 pounder Parrott rifles mounted in pivots fore and aft, and four 9-inch Dahlgren smoothbores.

USS Indianola

The *Indianola* was built in Cincinnati with dual paddle wheels, and dual propellers. Her armor was 3 inches of iron over 36 inches of timber. She was taken from the yards before completion, due to a Confederate threat from across the Ohio river. She was fitted and deployed the next month. Except, by then, the river level had dropped and she couldn't get past Louisville. She waited for the water to rise in January of 1863, and saw service in the Mississippi and Yazoo Rivers. She went down past Vicksburg and joined *Queen of the West*, a sidewheel steamer fitted out as a ram.

She was 174 feet long, 50 feet wide, had a draft of 5 feet. She had dual 11-inch smooth bore Dahlgrens, and dual 9 inch Dahlgrens.

Later, in the Red River, she was attacked by two Confederate rams, one, her old companion *Queen of the West*, now in Confederate hands. She was hit seven times on each side, and finally ran aground on the riverbank to avoid sinking.

Interestingly, the Union Navy made a fake ironclad from an old coal barge, using painted tree trunks for guns. It had barrels and stacks, with smudge pot providing the smoke. A Confederate salvage crew was working the captured *Indianola*, but abandoned

her, and set off her ammunition, when the fake ship arrived.

After the fall of Vicksburg, she was refloated and taken back to Mound City, Il, to be decommissioned and sold as scrap.

USS Kalamazoo

The *Kalamazoo* was the first in a planned series of ocean-going ironclads. She was unfinished at the end of the war, as were her three sister ships, and did not see action. The series was designed by Benjamin Delano of New York. They were to have twin turrets, 10 inches of side armor, over 12 inches of wood. The deck armor was to be 3 inches, and the turret armor 15 inches. The ships would be 345 feet long, with a beam of 56 feet, and a 17 foot draft. They would displace 5,660 tons, making them the largest ships to be built in Navy shipyards.

Unseasoned wood was used in the construction, with was a mistake, probably due to urgency. There were two dual cylinder steam engines, each driving a 15 foot propeller, supplied by eight boilers. This would give a calculated 2,000 horsepower, and drive the ship at 10 knots. The armament was to be four smooth bore 15 inch Dahlgren guns, firing a 350 pound shell to 2,100 yards.

The *Kalamazoo* was built in the Brooklyn Naval Shipyard. Sister ships would be the *Passaconaway* at the Portsmouth Naval Shipyard, the *Quinsigamond* at the Boston Naval Shipyard, and the *Shackamaxon*, at the Philadelphia Naval Shipyard. Construction on the ships was kicked off in early 1864. Work stopped at the end of the war. The unseasoned wood rotted, and all the ships were broken up by 1874.

USS Keokuk

The *Keokuk* was built at J. S. Underhill Shipbuilders, in New York City. She was commissioned and launched in December of 1862. Unlike other designs which had iron plate armor over wood, she was constructed mostly of iron. Her composite armor consisted of 1 inch by 4 inch horizontal iron bars alternating with the same size

yellow pine. These were sheathed with ½ inch rolled iron plate. The deck was made of 5 inch wooden planks covered with ½ inch iron plate.

She had two, non-rotating gun turrets, each with three gun ports. Each turret had an 11-inch Dahlgren gun on a rotating carriage.

She had a total of nine steam engines, with two providing power to the propeller. She also had fore and aft flooding tanks, to adjust her waterline.

She left New York in March of 1863 to join the South Atlantic Blocking Squadron. She got one of her propellers fouled in a buoy line, and had to return to Newport News for repair. She later arrived at her station at Port Royal, SC. She joined fellow iron clads USS *New Ironsides*, and the monitors *Weehawken*, *Passaic*, *Montauk*, *Patapsco*, *Catskill*, *Nantucket*, and *Nahant*, under Rear Admiral DuPont.

During the action at the first Battle of Charleston Harbor, the *Nahant's* pilot was killed when the pilot house was hit. *Keokuk* had to run interference for her. In the process, she was hit by 90 shot. Her composite armor was inadequate. She began taking on water, and sank off Morris Island. The Quartermaster, Anderson, received the Medal of Honor for his role in the battle.

An evaluation showed she could not be refloated, as she had filled with sand while submerged, so she was abandoned. The Confederates immediately mounted a salvage operation to get the two Dahlgren guns. This was successful. One of these remains in Charleston, at White Point Garden at the waterfront. The Singer Submarine Company's best design was stuck in 9 fathoms of water in Charleston at the bottom of harbor, with 8 men aboard. It was eventually recovered, and the men were laid to rest in Magnolia Cemetery.

USS Lexington

The *Lexington* was a side wheel steamer built in Pittsburgh, and purchased by the War Department. She went to Cincinnati to be fitted out as a gunboat.

Demonstrating the problems of protection for side wheels or stern wheels, an 8-inch shell from *Lexington* damaged the CSS *Jackson's* starboard wheelhouse. *Lexington* supported Grant's army with grapeshot and canister.

Serving with the Western Flotilla, she participated in the battle of Shiloh, on the Tennessee River. She then went down to the White River to participate in the Battle of Vicksburg. She also served in the Cumberland River. She was involved in a furious battle with Confederate infantry

At this point she was using an interesting invention of Thomas Doughty, essentially, a periscope to allow the turret crew to direct gunfire without exposing themselves.

The *Lexington* was de-commissioned at Mound City, Illinois, and sold.

USS Marietta

The *Marietta* was the first of a two-boat class that never was completed. They were part of the scramble to acquire ironclads, right after the battle at Hampton Roads. They were started in 1862, and suffered from a lack of available labor. They were completed, but not needed, in December, 1865. They were accepted by the Navy in 1866, and sold in 1873, never having seen action. They resembled the USS *Ozark*. They had a single turret, with the pilot house on top. They were 177 feet long, 50 feet wide, and a draft of 5 feet. They had four boilers supplying two standard steamboat engines driving a single propeller, and there were two 11-inch Dahlgren guns. The turret had 6 inches of armor plate, and the hull had 1¼ inches. They were being built by Tomlinson and Hartuppee in Pittsburgh. *Marietta* was laid down in 1862, and launched in

1865. She was accepted by the Navy but never commissioned. She was laid up at Mound City, IL and was sold in 1873. Sister ship *Sandusky*, launched in January of 1865, was completed in December, and accepted by the Navy in April of 1866. She was never commissioned, and sold at Mound City in 1873. A sister ship was the *USS Sandusky*. .

USS Miantonomoh

This ship was built at the New York Navy Yard, and was commissioned in September of 1865. She had two turrets, and twin propellers. She would be the first ship of her class. She first served in the North Atlantic Squadron. She had four 15” Dahlgren guns, two in each turret. She had 5 inches of side armor, a ½ inch of deck armor, and 10 inches of iron on the turrets.

She was 258 feet long, 52 feet wide, and had a draft of 12 feet. Four boilers generated steam for the engines, which generated around 1,400 horsepower for the propellers. She could achieve 7 knots.

She evidently saw no action, but was chosen for an extended trip to Europe, after the war. She was supposed to observe and collect data from (spy on) various Naval facilities. Part of her cover was to carry a copy of a Joint Resolution of Congress to Alexander II of Russia, congratulating him on his escape from an assassination attempt. She carried a complement of 150.

She was certainly seaworthy, and crossed the Atlantic in 11 days, with two other ships. She visited England, France, Denmark, and then spent a month at a Russian Naval Base.

She went on to Sweden, Prussia, Germany, Portugal, Spain, and Italy. She visited Gibraltar, the Canary and Cape Verde Islands, and ports in the Caribbean including the Bahamas. Returning, she was decommissioned in Philadelphia, but later re-commissioned, and served in the North Atlantic for two more years. She was decommissioned at Boston, and broken up in 1875.

USS Monitor

The iconic *Monitor* was the second ironclad warship to be commissioned into the Navy, after the USS Carondelet. Monitor was chiefly the work of John Ericsson, but the turret concept and design came from Theodore Timby. The ship was steam driven. It was built in Brooklyn, New York. Leaked news said the Confederates were building an armored warship at the old Union shipyard near Norfolk. Ericsson was in the right place at the right time, with the right plans.

The design was reviewed by the Ironclad Board, instituted by the Secretary of the Navy, Gideon Welles. It consisted of Commodore Joseph Smith, Commodore Hiram Paulding, Commander Charles Davis, and Gustavus Fox, Secretary of the Navy. They had to wade through seventeen submitted proposals for something that hadn't really been invented yet. It was all new-fangled technology. The board selected several projects to proceed. One was Ericsson's *Monitor*, another by Busnell, would become the USS *Galena*. Busnell sought advice from Ericsson, and there was cooperation, not competition.

Monitor was 179 feet long, 41 feet wide, and had a draft of 10 ½ feet. She displaced 987 long tons (2200lbs). She had a crew of 49, all volunteers.

Her steam engine was an Ericsson design, fed by two boilers, and the ship could achieve 8 knots. The ship had dual centrifugal blowers at the stern, to provide ventilation for the ship, and air for the boilers. Steam pumps took care of leaks.

The turret was 20 feet in diameter and nine feet high. It had 8 inches of armor plate, 11 inches in front of the gun ports. There were two steam engines to rotate the turret. A complete rotation took about 22 seconds. The entire weight of the turret, more than 160 tons, rested on a 9 inch diameter spindle. The turret was lifted up with a wedge before use, otherwise it rested in a brass ring, which proved to be less than waterproof. When in use, the turret rotation sometimes jammed due to shell fragments.

Access to the turret from the hull, to supply shot and gunpowder, and allow crew to pass, was only possible when the turret faced starboard. The roof plates of the turret were not fastened. The turret held two 11-inch Dahlgren guns, each weighing 8 tons. Using 15 pounds of powder, they could put a 136 pound shot two miles. In battle there would be eighteen men in the turret.

Monitor didn't present much of a target beyond the turret, as the deck was only about 18 inches above the water. In addition, Ericsson paid for outfitting the officer's wardroom, including an oriental rug.

In case it were necessary to rebel boarders, it was planned to use steam hoses.

The contract for the *Monitor* was valued at \$275,000. Ericsson signed over his *Monitor* patents to the government, as his "contribution to the Union."

Monitor's hull was built at the Continental Iron Works in Brooklyn. In parallel, the turret was assembled at the Novelty Iron Works in Brooklyn. The engines and machinery were supplied by DeLamater Iron Works of Manhattan. Chief Engineer (of the Navy) Stimmers was Superintendent of the ship during construction and trials.

Monitor was launched on January 30, 1862 and commissioned February 25. She had conducted sea trials earlier, on February 19. Teething problems with main engine valves, and the ventilation fans keep her from reaching the Brooklyn Navy Yard under her own power, and she was towed.

She set out for Hampton Roads a day late, due to last minute ammunition loading. In the East River, she had steering problems, and had to go back to the Navy Yard for repairs. She also conducted gunnery trials.

On March 6, she finally set out from New York in tow by the ocean-going tug, *Seth Low*. She was accompanied by two gunboats. Warden tampered with the turret seal, and as a result, water poured into the turret and the funnels, the ventilation fan

belts came off, and the ship was filled with fumes. Later, the the ship's rudder jammed. She was in danger of sinking, so was towed close to the shore. The problems finally got fixed, and she was underway again. Being so low in the water, *Monitor* had unique flush toilets.

The news of the *Virginia* reached Washington in time to start a panic. Some sixty canal boats were loaded with stone, and readied to sink in the Potomac if, worst case, the *Monitor* was sunk and the *Virginia* was on its way.

The details of the epic battle are told in many different sources. It was a draw at best, but *Monitor* stopped the destruction of the Northern wooden Navy by *Virginia*.

Lincoln had visited the *Monitor* in May of 1862 at Hampton Roads.

After the encounter with the CSS *Virginia*, the *Monitor* went to Sewell's Point to attack the gun battery's there. She was accompanied by the *Galena*, and the wooden hulled *Aroostook*, and *Port Royal*. The big problem was the Confederate battery on Drewry's Bluff, *Monitor* could not elevate her guns enough to return fire from that location. *Monitor* had loaded canister shot for use against troops. The ships were in support of McClellan's Army, who were trying to take Richmond. Fort Monroe was their supply and communication point. In June of 1862, they went up river.

In an interesting action, *Monitor* went up the Appomattox River to destroy a key railroad bridge. She was accompanied by the submarine *Alligator*, in tow, that was to do the actual destruction. The mission was not a success, but it may have been the first ironclad-submersible joint action.

McClelland was not victorious in taking Richmond, and the *Monitor* returned to City Point, downriver. She did participate in the Battle of Malvern Hill. She remained in the river for 2 months. She would be the last to leave. The whole James River action was abandoned.

At the time, the Confederates were finishing up their new ironclad, *Richmond*, in the City of the same name. The *Monitor* had to stay on the James River to block her. Meanwhile, the Union *New Ironsides* was under construction in Philadelphia. *Monitor* needed to be relieved for work on her engines and boilers. The crew did repaint her from the factory black, to a “battleship” gray.

The *New Ironsides* came to relieve the *Monitor* in September of 1862, and she went to Newport News for an overhaul of her machinery. She went up the Chesapeake in tow to the Washington Navy Yard. In October, she reached the Capital City, and was seen by large crowds. While she was being worked on, the crew berthed on a nearby ship. Her engines were overhauled, and ventilation was improved. The crew was back onboard by November. On the eighth, she left the yard under her own power, and headed back to Hampton Roads. From there, she was taken in tow by the sidewheel steamer *Rhode Island*, headed to Wilmington and Cape Fear, NC. She was assigned to intercept blockade runners in that port. She went with the *Passiac* and *Montauk*. They went into the open seas beyond Fort Henry, and the seas were heavy. *Monitor* was taking on a lot of water, and two sailors were lost trying to cut the tow cable. A third brave individual got it done. The *Monitor* was floundering in the heavy seas, and men were being taken to the tug via ships' boats. Eventually, the *Monitor* took on so much water the engine fires were drowned, the pumps stopped, and she sank, with the loss of 16 of the crew.

After she was located, navy divers were successful in recovering the steam engine, the turret, the propeller, and the guns.

There were two sets of remains in the turret. These were sent to the Forensic Anthropologists at the Joint POW-MIA Accounting Facility in Hawaii. They narrowed the identities down to several individuals. The remains were buried with full military honors at Arlington National Cemetery in 2013.

USS New Ironsides

The *New Ironsides* resembled the CSS *Virginia*. It had sails as well as two steam engines driving a thirteen foot propeller. It was proposed to the Navy by the Philadelphia-based Merrick & Sons engine works. They couldn't handle a ship at their facility, so they subcontracted that part to William Cramp & Sons, Shipbuilders.

The steam engines were supplied from four boilers, giving an overall 1,800 horsepower to drive the ship up to 6 knots. The propeller could be disengaged when the ship was under sail.

The sail configuration was a barque-rig with three masts. Masts and rigging could be removed and stored when the ship was on battle station. She could hit 7 knots under sail.

She was equipped with fourteen 11-inch Dahlgren guns, two 8-inch Parrot rifles, and two fifty pounder Dahlgren rifles, later replaced by 60 pounders. These were mounted forward. The gun ports were a limitation to elevating the guns more than a few degrees. This limited range, as well as the ability to return fire to a shore emplacement on a hill, next to a river.

The armor included a waterline belt of wrought iron, 4.5 inches thick, 3 inches below the waterline. The 170 foot long caisson had 4.5 inches of armor plate on the sides, the forward and aft being left unprotected. On top of the decking was 1 inch of wrought iron.

All gunports had armored shutters that rotated when a rope inside the casemate was pulled.

The metal plate was secured with screws. The plates had a groove on each side, into which an iron bar was placed. This arrangement distributed impact forces. Side armor was backed with 21 inches of wood. There was a small armored conning tower behind the funnel and mainmast, with no visibility to the front.

She was launched in 1862, and commissioned in August. She immediately went to Hampton Roads to face a Confederate fleet coming down the James. She had a gun recoil problem. She was repaired and modified on site, with steam up, in case quick action

was required. The funnel was lowered to increase visibility from the conning tower, but the smoke and fumes were too bad there, and the funnel was restored. They had the brilliant idea of moving the conning ahead of the stack and mast, but it was too heavy to do in the field.

In 1863, she joined the South Atlantic Blocking Squadron. She served in the first battle of Charleston Harbor, as part of the bombardment of Fort Sumpter. While the Admiral was aboard, *New Ironsides* collided with *Catskill* and *Nantucket* with no damage reported by anyone. She also got very lucky after anchoring above a 3,000 pound Confederate mine (then called a torpedo), that failed to detonate. She was hit some 50 times with shot with no major damage.

In the second battle of Fort Wagner, and the second battle of Charleston Harbor, she was the target of a another failed spar torpedo attack.

Fort Moultrie received some 483 shells from *New Ironsides*. She was hit at least 70 times. Overall, she fired a total of 4440 shells and was hit by 150.

She was attacked by the Confederate semi-submersible CSS *David* with a spar torpedo, with minor damage and one fatality.

In October, she joined the North Atlantic Blocking Squadron at Hampton Roads. She was part of the assault on Fort Fisher, NC. The assault was called off on Christmas day, but resumed in January of 1865. The fort was then taken by ground assault. Eight of her crew received the Medal of Honor. She spent the rest of her time on the James River, before going back to Philadelphia. There she as destroyed by a fire, towed to shallow water, and sunk. Some of the ship was salvaged.

USS Onondaga

Onondaga was a river monitor that was in active service with the James River Flotilla. She was built at the Continental Iron Works in New York. The engines came from the nearby Morgan Iron

Works, which specialized in marine steam engines. The shipping and railroad magnate Charles Morgan was an investor. The Works produced engines for 23 ships during the Civil War.

She had 8-inch Parrott rifles, and 15 inch Dahlgren smoothbore cannon in dual turrets.

Along with the wooden gunboat USS *Mattabesett*, she left New York in early 1864 en route to Hampton Roads. She served in Grant's Campaign against Richmond. Most of the ships went to support the attack on Fort Fisher, NC, leaving the *Onondaga* to patrol the James. After good service, she was decommissioned at New York. She was sold back to her builder, who subsequently sold her to France. She was finally scrapped in 1904.

USS Osage

The USS *Osage* was a single turret monitor. She was built at the Union Iron Works, Carondelet, Mississippi, and commissioned at Cairo, Illinois. She was 180 feet long, with a beam of 45 feet. She had a burthen of 523 tons. The ship had four boilers that fed an engine that ran the stern wheel. She had a crew of 100.

The vessel was equipped with two smoothbore 11 inch Dahlgren guns. The gun turret was moved by steam. The turret had six inches of wrought iron armor, and the hull had 2.5 inches of armor.

She did good service, but was grounded on a sandbar in Arkansas, during a period of low water. Significant damage was done to the vessel, but it was repaired in place, and re-floated. She stuck a mine at Mobile, Alabama, while serving in the West Coast Blockading Squadron. After the war she was refloated and sold at auction in New Orleans. The USS *Neosho* was similar. She participated in the Battle of Nashville, and patrolled the Cumberland River. After the war, she was decommissioned and sold in 1873.

She served as part of the Mississippi Squadron, and served in the Red River Campaign. She wound up being trapped on a sandbar for 6 months near Arkansas. After she was refloated and repaired at

Mound City, she went to the West Gulf Blocking Squadron in actions against Mobile, AL. She sank after hitting a mine at the Battle of Spanish Fort. She was later salvaged and sold.

Osage was 180 feet long, 45 feet wide, and 543 tons in weight. The Dahlgrens could fire a 136 pound shell to 3,600 yards. The turret had 6 inches of wrought iron armor. With 2.5 inches on the hull. The deck and paddle wheel housing had 1.25 inches of iron.

USS Ozark

Ozark was a single turret river monitor, the first of her class. She entered service in 1864, served in the Mississippi River Squadron, and saw action in the Red River Campaign.

Ozark was 180 feet long, 50 feet wide, and had a draft of 6 feet. She had two steam engines driving 7 foot propellers, and fed by four boilers, from the Franklin Foundry in St. Louis. She had a top speed of 9 miles per hour, and had triple rudders. The pilot house was on top of the turret.

The ship was constructed at the Mound City Marine Ways shipyard. This started in 1862, and she later went to St. Louis for fitting out. She was commissioned into the Navy in February 1864.

In the turret, there were two 11 inch Dahlgren guns. They were capable of throwing a 136 pound shell 1700 yards. She was up-gunned by the addition of four additional pieces, one each at the bow and stern, and one on each side. These were in pivot mounts. The turret had 6 layers of 1 inch wrought iron plate. The first forty feet of the hull had had 2.5 inches of plate, extending a foot below the waterline. The rest of the hull had slightly more than 1 inch of protection. The deck had 1 inch of plate.

The *Ozark* was a single turret monitor. She was decommissioned after the war, but mentioned as transporting New Orleans police and Federal Troops, as well as witnesses during the Colfax Massacre by white supremacists in 1873. During the trial, witnesses were kept onboard the docked ship.

Ozark was propeller -driven, and had been built at the Franklin

Foundry in St. Louis. She had two 11-inch Dahlgren guns. She was later up-gunned, and tested a strange underwater 9-inch Dahlgren gun.

She was decommissioned at Mound city in July of 1865. She was sold, but the name of the purchaser had been lost. Her disposition is unknown

USS Passaic

Passaic was built at the Continental Iron Works in New York. Her engine was built by the DeLamater Iron Works. These companies were subcontracted by John Ericsson. She had the single turret design originally developed by Ericsson. She was launched in August of 1862, commissioned in November, and served until 1898. She was sold at auction in 1899.

She was 200 feet long, 46 feet side, and a draft of 12 feet. She had two boilers feeding an Ericsson-designed engine. She had a 12 foot diameter propeller, and could achieve 7 knots. She had a crew of 85. Her armament consisted of an 11 inch, and a 15 inch cannon in the turret. The side armor was 5 inches, with 11 inches on the turret. The deck was protected by 1 inch of iron plate.

She served with the North Atlantic Blockading Squadron Hampton Roads, but she had to leave station and go up to the Washington Navy Yard for repairs. She and the (original) Monitor left in tow for Beaufort, NC. In bad weather off Cape Hatteras (which would prove fatal for the Monitor), she took on water at an alarming rate. She disposed of her shot overboard to remain afloat.

On station, she participated in several actions at Wassac Sound, where she captured a schooner loaded with cotton. She participated in the attack of Fort McAllister, and the attack on Charleston. She then had to go back to New York for extensive repairs. She then returned to Charleston Harbor, serving as Admiral Dahlgren's flagship, and rescuing the USS *Lehigh*, which had run aground.

She was decommissioned at the Philadelphia Navy Yard in June, 1865, and was stored there until 1874. She was repaired and

refitted, and recommissioned in 1876. She went up to Washington, D. C., then was posted to the Naval Academy, in Annapolis, MD in 1883. In 1892, she went to the Boston Navy Yard. In 1894 she was loaned out to the Massachusetts Naval Militia and then to the Georgia Naval Militia as a training ship. She wasn't done yet. In 1898, she was recommissioned and assigned to the Naval Auxiliary Force as a supply ship, and served at Key West and Pensacola. She was decommissioned for the last time in 1898, and sold to a private buyer in 1899.

Passaic lead a class of iron clads, including *Montauk*, *Nahant*, *Patapsco*, *Weehawken*, *Sangaamon*, *Catskill*, *Nantucke*, *Lehigh*, and *Camanche*, all of similar design.

The *Passaic* class monitor was derived from the original Monitor design. Their use continued into the Spanish-American War. They were up-gunned with 15-inch Dahlgren guns. They were larger than the original *Monitor*, and the pilot house was moved atop the turret. It had upgraded deck plating, and minor improvements from “lessons-learned” from the *Monitor* and its cousins. It was a two-turret design, that cost around \$300,000 - \$400,000 per unit.

The *Passiac* class impressed the Russians, who built their own, the *Uragen* Class, for service for the Baltic Fleet. Ten were built in 1865 in St. Petersburg, the first ironclad war ships of the Russian Navy.

USS Puritan

Puritan was designed as a dual turret ironclad monitor, later modified to Ericsson's single turret design. Ericsson subcontracted with the Continental Iron Works of New York with machinery from Allaire Iron Works in New York City. She was launched in July of 1864. Construction was suspended when there were problems casting her 20 inch smooth bore cannon. She sat out the war, but generated interest in the Secretary of the Navy. She needed extensive work, and mired in scandal, was never completed.

She was designed to be ocean-going, 340 feet long, with a beam of 50 feet. She had six boilers feeding a steam engine driving a propeller. She could achieve 15 knots. Her gun turret had 15 inches of armor plate, a belt at the waterline was six inches thick, and the pilot house was protected by 12 inches of plate.

She was broken up in 1874, never having seen action.

USS Queen City

The *Queen City* was a wooden side-wheel steamer bought by the Navy in Cincinnati, and commissioned in 1863. She was a “tinclad,” being lightly armored. She supported Army operations on the Tennessee River, later patrolling the Mississippi. She was used to carry troops. In Arkansas, the ship was attacked by two regiments of Confederate cavalry with associated artillery. She was disabled, and forced to surrender. Later, when the Union forces tried to recover her, she was blown up.

USS Roanoak

Roanoak was converted from an existing three-masted steam-screw frigate. Originally launched in 1855, she was well armed. She was at Hampton Roads for the encounter of the *Monitor* and *Virginia*. But, she not able to move, because her propeller shaft was broken. She was used for her fire power, hosting some 44 heavy guns. When the *Virginia* came out to attack, the *Roanoak* ran aground. Seventeen days after the incident, she was taken out of service to be transformed into a turret ship. The work was done by Lenthall and Isherwood. The work was slowed because the Navy had specified 4.5 inch plate armor, not laminated armor. The Navy couldn't produce it, so they had to go to the Novelty Iron works of New York. The original design called for four turrets, but this was not deemed possible, so it was changed to three.

She was 265 feet long, 52 feet wide, with a displacement of 6,300 tons. There were eleven inches of armor on her turrets, 4 ½ inches on her sides, and ½ inch on deck. Two steam engines drove a

single screw. She could achieve 6 knots. The fore and aft turrets had a 15 inch Dahlgren gun and a 150 pounder Parrott Rifle. The middle turret had one 15-inch and one 11-inch Dahlgren.

The excessive weight of the vessel with its armor and armaments caused the ship to draw too much water, and the hull eventually sagged. During the war, she served as a harbor defense ship at Hampton Roads. She was placed in reserve at the end of the war, later decommissioned and sold.

USS Tecumseh

Tecumseh was a *Canonicus* class monitor. She first served in the James River Flotilla, later went to Mobile Bay under Admiral Farragut.

Hit by a mine in Mobile Bay on August 5, 1864, she sank with 100 men aboard, on April 12, 1864.

The ship was a single turret monitor, 223 feet long, 43 feet wide, drawing 13 feet of water. She displaced 2100 tons of water. She had a crew of 100. The ship had two steam engines, driving one propeller. The engines were supplied by two boilers. She could get up to 8 knots. She had two 15 inch Dahlgren guns in the turret. They could put a 350 pound round up to 2,100 yards.

She had five inches of wrought iron plate on the hull. The Gun turret had 10 inches. The deck armor was 1.5 inches thick. The turret was upgraded by the addition of an iron band around the base, to prevent jamming by enemy shell. This was one of the early lesson-learned in armored combat. Another was the rifle screen for the turret top.

She was built by Charles Secor & Co in Jersey City, N.J. She was launched in 1863, and commissioned in 1864. She had a deepened hull, to increase buoyancy.

She first went to the North Atlantic Blocking Squadron, at Newport News. She sank 4 hulks and a schooner in the James River to prevent Confederate traffic.

She left to join the West Gulf Blocking Squadron at Pensacola. In Mobile Bay, she struck a torpedo (mine) and sunk in 30 seconds. Ninety four crew went down with the ship. She rests at the bottom, upside down. Because of the remains of the crew on board, the ship is protected by law. The Smithsonian located her in the mid-1960, but did not have the funds to recover the ship. Current estimates are \$80 million for the salvage. She is considered a war grave.

USS Tennessee

The USS *Tennessee* was the former CSS *Tennessee*, captured at Mobile Bay. She went on to fight in the successful assault on Fort Morgan. She then went to New Orleans, in Union hands by then, for repairs. Before being decommissioned, she served on the lower Mississippi River. She was sold at auction and scrapped. Parts of her armament is on display at the Washington Navy Yard.

USS Vanderbilt

The USS *Vanderbilt* was a large passenger steamer used by the US Navy. It was modified for ramming Confederate blockade runners. The Commodore of the Navy suggested plating the bow with iron, and backing that with concrete.

USS Winnebago

Winnebago was a double-turret *Milwaukee* class ironclad. She helped out at the Battle for Mobile Bay, and the subsequent attacks on the fortifications of the City. She went into reserve at the end of the war, and was sold in 1874.

She was 229 feet long, 56 feet wide, and a draft of 6 feet. Her crew included 138 officers and men. She had two steam engines, each driving propellers, fed from seven boilers. She could achieve 9 knots.

Each turret had two 11 inch Dahlgren guns. The rear turret was a

Ericsson design, but the front turret was by James Eads, a civil engineer and inventor. He was responsible for producing the City-class Ironclads, and produced 30 ironclads during the war. He also designed and built the first road and rail bridge across the Mississippi at St. Louisville. This was, at the time, the longest arch bridge in the world. It is still in use.

The turrets were protected by eight layers of 1 inch iron plates. The hull had three layers, and the deck was protected by 0.75 inches of plate.

Structure and Organizations

This section will discuss the various flotillas and squadrons in which ironclads were organized. Some of these were based on a location, like a blockade, and some were for specific actions against enemy targets.

The Mississippi River Squadron

The Mississippi River Squadron started out as an Army outfit in May of 1861, with Navy Officers, but was later transferred to the Navy in 1862 after the battle of Memphis. It was then under the command of Read Admiral David Porter. It was renamed the Western Gunboat Flotilla. The Mississippi squadron consisted of ten ironclads, three monitors, a timber-clad, a ram, and a series of support and logistics vessels. The gunboats subdued the fort before Grant arrived. The Squadron also supported Pope's Army of the Mississippi. It saw action at Memphis, and then transferred to Naval Service, where it saw action at Vicksburg.

The Mississippi River Squadron went down the Tennessee River to support Grant's action against Fort Henry.

It saw action in the Red River Campaign in 1864, which proved such a disaster. It had, at the time, a single turret monitor, two twin turret monitors, nine casemate ironclads, the timberclad Lexington, protected by 5 inches of oak, and three side-wheel steamers for

logistics.

The casemate iron clads of the Mississippi River Squadron included the *Eastport*, *Essex*, *Baron DeKalb*, *Benton*, *Carondelet*, *Cincinatti*, *Louisville*, *Mound City*, and *Pittsburgh*. These did not have turrets, and were sometimes used as rams. The USS *Eastport* had been captured from the Confederate Navy, while it was being built. She was finished at Cairo, Il., but struck a mine in the Red River, and was destroyed to prevent her capture.

Blocking Squadron

The Union Navy set up their *Anaconda Plan*, to strangle the South by a blockade. This was quite an ambitious plan, stretching down the Atlantic Coast, around Florida to the Gulf Coast. One organization was the Coast Blocking Squadron, later renamed the Atlantic Blocking Squadron. This was in turn split into the North and the South Atlantic Blocking Squadrons. The North Atlantic Squadron was responsible for the coast line between the Potomac River and Cape Fear North Caroline. The South Squadron from Cape Henry, Virginia, to Key West, Florida. The Gulf Squadron was responsible for Key west to the Mexican Border. Later, this was split into East and West Squadrons. The East Squadron was responsible for the coast line between Cape Canaveral to Pensacola. The squadrons were also responsible for blocking Confederate troop movements by sea or river.

The problem was complicated, as the South had 3,500 miles of coastline and twelve major ports. The North employed 500 ships to enforce the blockade. Great Britain aided the south with purpose-built blockade runners. They needed the cotton. The Union Navy claimed capture of more than a thousand ships, and the destruction of 350 more.

The Confederate States were quick to employ Blockade Runners, fast sailing ships. They needed manufactured goods from Europe, and about their only viable cash crop, cotton, went to Europe as well. In the author's home town, a cotton mill had to close down

for the duration of the war. Conventional wisdom says cotton won't grow north of the Potomac. Material made from cotton was needed for ship's sails, army tents, wagon covers, knapsacks, etc.

Blockade runners were specifically built for speed and stealth. They did not hope to stand up to a gunship, but merely get where they were going. Britain, in particular, was hard hit by the embargo of southern cotton for manufacturing. At the same time, they were suffering from a cotton famine at home.

Potomac Flotilla

The Potomac Flotilla was formed to secure the Chesapeake Bay. You can't go up the Potomac beyond Washington anyway. Its commander was James Ward. Three light draft vessels were sent from the New York Navy Yard, with the *Thomas Freeborn*, the *Reliance*, and the *Resolute*. They arrived at the Washington Navy Yard, up river on the Anacostia from the Potomac, in May of 1861. First action was in June, at Mathias Point, Virginia. Ward was unfortunately killed in this first action. The flotilla conducted patrols, but saw no further major action. It was disbanded in July of 1865. The ships were de-commissioned at the Washington Navy yard.

The ironclads involved included the *Casco*-class *Casco* and *Chimo*, the *Mahopac*-class *Mahopac* and *Saugus*, and 4 screw sloops, one of which was the flagship. The Flotilla also included 2 sidewheel and 19 screw gunboats, and numerous auxiliary craft.

City class Ironclads

The *City* class ironclads, also called *Pook's Turtles* after Samuel M. Pook, who was experienced in building rivercraft. He was out of Cairo, Il. The *City* class were designed to operate on the Mississippi. They were also called Eads gunboats, after the owner of the shipyard where they were built, James Eads of St. Louis. The *City* class were the US's first ironclads. What about the *Monitor*, you say. The War department funded the *City* class project, and the

ships were Army property. The *Monitor* was the Navy's first Ironclad, commissioned a month after the first of the *City* class.

The *City* class ships formed the core of the *Western Gunboat Flotilla*.

In the early days of the Civil War, Eads offered one of his salvage vessels to the Federal government for conversion to a warship for use on the river systems. The particular vessel, the *Submarine number 7*, was a catamaran. The offer was not accepted.

The Pook design drew 6 feet of water, ideal on the rivers. It had 13 guns, with 2.5 inches of armor plate on the casemate. The weight of the armor was 75 tons. The boats had three keels. There was a single center-line paddle wheel. They were 175 feet long, 51 feet wide. The cost to the government was under \$90,000 per boat. As with most government contracts, the price doubled before any were delivered. By 1862, they were delivered to the Army. The *City* class boats were named after *Citys* on the Mississippi. The first four were built at the Carondelet Marine Ways in St. Louis. Here there were dry docks, a supply of skilled workers, and machinery firms. The last three boats of the class were built at the Mound City Marine Railway & Shipyard.

The ships were designed for 13 guns, three forward, two aft, and 4 each on the sides. Most of the ships carried six 32-pounders three 8-inch Dahlgren, and four 42-pounders.

There were five boilers feeding dual steam engines, driving the 22 foot paddlewheel.

River Defense Fleet

The *River Defense Fleet* was a Confederate unit consisting of fourteen ships to defend New Orleans. These were all seized and converted merchant vessels. They were technically a part of the Army, but mostly crewed by civilians.

This fleet was overwhelmed by the Union forces. It was out of

service by 1862. The ships were lightly armed, not capable of slugging it out with the heavier Union ships. They were intended as rams.

The vessels had their decks covered with oak sheathing, and reinforced with railroad iron. They could be called cotton-clads, as they had bales of cotton between the inner bulkhead of twelve inch oak, and the outer bulkhead..

The vessels *Stonewall Jackson*, *Warrior*, *Defiance*, *Resolute*, *General Breckinridge*, and *General Lovell*, remained around New Orleans. The *General Bragg*, *General Sterling Price*, *General Earl Van Dorn*, *Colonel Lovell*, *General Beauregard*, *General M. Jeff Thompson*, *Little Rebel*, and *General Sumter* remained around Memphis.

At New Orleans, there were three separate commands. These included the Confederate States Navy, the Louisiana State Navy, and the River Defense Fleet. As Farragut's Union Fleet ran the Mississippi forts and approached the City, the *Stonewall Jackson* was able to ram the USS *Varunaw* while it was simultaneously being rammed by the Governor Moore of the Louisiana navy. The *Varuna* sank, the only Federal ship that was lost. *Warrior* was destroyed by a broadside from USS *Brooklyn*. The *Resolute* was run ashore, abandoned and burned, along with the *General Breckenridge* and *General Lovell*. That left only the *Defiance*. That ship was burned to deny it to the Union Fleet.

Only eight Confederate vessels remained above New Orleans. They surprised and attacked the Union fleet at Plum Point Bend. The Union vessels *Cincinnati* and *Mound City* were run aground to avoid sinking. They were back in service within two weeks time.

A month after Plum Point, the two fleets engaged again at Memphis. One Union ram was sunk, but later recovered. Seven of the eight Confederate vessels were sunk or captured. Only the CSS *General Van Dorn* escaped. She had earlier rammed the Union

Ironclad USS *Mound City*. This ship had been built by Industrialist James Eads. It had two Pittsburgh engines, each driving one side paddle wheel. The casemate armor was 2.5 inches. There were originally going to be twenty guns, but a weight issue with the armor reduced this to thirteen. The guns installed were those available, including 8 inch smooth bore cannon or 32- or 42 pounder “rifles” which were actually re-machined smooth bore canon.

James River Squadron

The James River Squadron was formed just after hostilities began , and it was part of the Navy of Virginia, before being part of the Confederate States Navy. It transitioned from wooden ships to ironclads, and ended with the Battle of Drewry's Bluff. Ships in the later phase were the CSS *Virginia II*, *Richmond*, *Fredericksburg*, *Drewry*, *Patrick Henry*, *Teaser*, *Beaufort*, *Raleigh*, *Hampton*, *Nansemond*, and *Torpedo*. There were mostly continuous bombardments between the Squadron, and the Federal Shore battery's.

After the fall of Richmond, the ships were to be destroyed, and the sailors to join Lee's Army. Since they had no way to reach Lee's Army, they joined Johnson's Army, which then surrendered to Sherman.

Western Gunboat Flotilla

The Western Gunboat Flotilla met the West Gulf Blocking Squadron in battle at Vicksburg in July of 1862, which was inconclusive. The unit was originally under control of the Army, but was transferred to the Navy in October of 1862.

Confederate River Defense Fleet

This was a collection of 14 ships, engaged in the defense of New Orleans. None were ironclads, they have all been merchant ships with guns added. Some had 1 inch of railroad iron added.

Compressed cotton was fitted in the spaces between bulkheads, creating the term, *cotton-clads*. Although the organization was part of the Army. All of the officers, and most of the crew were civilians. The fleet was divided into a north and south sections. The southern section served at the battles of Fort Jackson and Fort St. Philip. The northern section saw action at Plum Point and Memphis. The total fleet was gone by 1862. The demise of the fleet marked the end of naval war conducted by amateurs.

Mississippi Marine Brigade

The Mississippi Marine Brigade was a Union Army outfit, part of the U. S. Ram fleet. The soldiers aboard were essentially what we would call Marines. The entire Brigade had infantry, cavalry, artillery, and a fleet. It saw major action at Vicksburg. The Naval portion included the ships, USS *Monarch*, USS *Lancaster*, USS *Switzerland*,, USS *Samson*, USS *Dick Fulton*, USS *T. D. Horner*, and USS *Lioness*.

In June of 1862, a ruling of the Judge Advocate General made the brigade, “special contingent of the army and not the navy.” Special Forces? Rangers? Even Grant wasn't sure how this was supposed to work, but in October, 1863, the Secretary of War said it was part of the Army.

United States Ram Fleet

The ram fleet was a part of the United States Army. Most of the ships were converted steam towboats. The first group had no cannon, but these were added later. They were lightly armored. They served in the defeat of the Confederate River Defense Fleet.

Mississippi River Squadron

This unit was part of the Army's “brown water navy” serving on the western rivers in 1861. It later became the Western Gunboat Flotilla.

North & South Atlantic Blocking Squadron

This structure was formed originally as the Coast Blocking Squadron, renamed the Atlantic Blocking Squadron in May 1861. Its purpose was to blockade the ports of the Confederacy, particularly those trading with Europe. It was then split into two areas of operation.

The North Atlantic Squadron was based out of Hampton Roads, Virginia and covered the coasts of Virginia and North Carolina, from the Potomac to Cape Fear. The South Atlantic Blocking Squadron operated from Cape Henry, Virginia, to Key West in Florida.

Gulf Blocking Squadron

The Gulf Blocking Squadron covered from Key West to the Mexican border, in the Gulf of Mexico. In 1862, it was split into the East Gulf and West Gulf Blocking Squadrons. East Gulf went from Pensacola to Cape Canaveral, with Headquarters in Key West. The West Gulf Blocking Squadron covered from the mouth of the Mississippi to the Rio Grande. It participated in the Battle of Mobile Bay, under Farragut.

United States Ram Fleet

The U. S. Ram Fleet served on the Mississippi River. It hosted converted river towboats with reinforced hulls. Some protection was added for boilers and engines. They were not armed, initially. They played a key role in the Battle of Memphis in June, 1862, and the many battles around Vicksburg. The unit was under command of the Army. There were nine ships, the *USS Monarch*, *Queen of the West*, *Lancaster*, *Samson*, *Switzerland*, *Mingo*, *T. D. Horner*, *Lioness*, and *Fulton*.

James River Squadron

The James River Squadron was formed after Virginia seceded from

he Union. It was a unit of the Virginia Navy, transferring to the Confederacy. It covered the James River, the entry point to Richmond, the Confederate capital. It initially was made up of wooden ships, augmented by the ironclad CSS *Virginia*.

Confederate River Defense Fleet

The Confederate river Defense Fleet consisted of 14 ships, assigned to New Orleans on the Mississippi. These were all converted from merchant ships, each having two guns. They were assigned to the Army, for Riverine service.

Campaigns and Expeditions

This section will discuss some of the campaigns in the Civil War that ironclads and submarines participated in. They were assigned to the Confederate States Army, for riverine service. Crews were mostly civilian. Most of the fleet did not exist by 1862.

The ships had some railroad armor, but mostly relied on the cotton stuffed between the bulkheads. Their primary offensive weapon was a ram.

The River Defense Fleet shared space in New Orleans with the Confederate States Navy, and the Louisiana State Navy. When Admiral Farragut arrived with his flotilla, there was a significant action that left the Confederates with only one ship in the Southern sector. She was burned when the City eventually fell.

The River Defense Fleet saw action against the Western Gunboat Flotilla at the battle of Memphis. The result was one Federal ram sunk, and seven of the eight Confederate vessels were sunk or captured.

Charlestown Campaign

This campaign involved Admiral DePont's naval assault on the city, and the subsequent blockade. It was at Charleston that the submarine CSS *Hunley* sank the Union warship *Housatonic*.

Red River Campaign

This action took place in Louisiana from March to May of 1864, and was pretty much a disaster for the Union. The Confederate vessels were not a match for their Union opponents, and were casualties of war by 1862. The fleet fought in the battles of Fort Jackson, St. Philip, Plum Point Bend, and Memphis.

The Union forces included the Navy's Mississippi flotilla consisting of ten ironclads, three monitors, eleven lightly armored tin-clads, a ram, and supporting and logistics vessels. The North controlled New Orleans, so shallow draft boats could come down the Mississippi, from the Ohio.

The South had the ironclad CSS *Missouri*, a casemate paddle wheel steamer, the CSS *Cotton*, and the CSS *Webb*, a ram. The *Missouri* spent most of the action trapped in Shreveport due to low water. It had armor of 23 inches of pine, to which iron rails were attached and a center paddle wheel. There were eight gun ports, two at the front, and three on each side. It surrendered to the U. S. Navy in June of 1865, the last Confederate ironclad to surrender.

The Union Navy ships included the *Reindeer*, *St. Clair*, *Springfield*, *Victory*, *Naumkeag*, and *Queen City*. The *Reindeer* was re-purposed from a civilian steamer, built in Cincinnati. It was a stern-wheeler. She was sold at auction after the war. Similarly, the USS *St. Clair* started out as a commercial stern-wheeler. After entering the Navy, she provided convoy protection on the Cumberland River, among other tasks. She was disabled and towed in action at Palmyra, TN. She was repaired, and later served on the Mississippi above New Orleans. The USS *Springfield* also started out as a civilian craft, a stern wheeler built at Cincinnati. She went on to operated on the Ohio, Tennessee, and Cumberland Rivers. After the war, she was decommissioned at Mound City, Il. Built in Cincinnati, The USS *Victory* served for two years. She was a lightly armored "tin-clad," assigned to patrol and reconnaissance on the Tennessee, Ohio, and Cumberland. The USS *Naumkeag* was also built in Cincinnati, a wooden stern-wheeler, as was the USS *Cumberland*. These were lightly armed "tinclads."

Yazoo Pass Expedition

This expedition was a joint Army-Navy operation, with General Grant's Army of the Tennessee and Admiral Porter's Mississippi Squadron in the battle of Vicksburg. Spoiler alert: it did not work out well for the Union.

At the beginning, a levee on the Mississippi was breached to allow water through an existing channel into the Wazoo River, and raise its level. This allowed the gun boats and troops carriers to proceed.

The Navy had seven gun boats, and a tugboat. Five of the gunboats were lightly armored tinclads. The other two were the *City*-class, along with infantry regiments in 13 transport ships.

Initially, the ironclad gunboats of the Union Army, coming in the backdoor, were repulsed by Confederate forces. The Navy commander's health failed, and he was forced to turn over command. During the actual fighting, *Chillicothe*'s armor was hit and buckled, so that the gun port coverings could not be moved, and she was forced to retire. The brass saw the efforts as fruitless, and withdrew the troops and boats.

Pacific Coast Theater

There was Naval action in the Pacific in the Civil War as well. Confederate and Union troops clashed in the New Mexico Territory. Both Union and confederate war ships operated in the Pacific, although no ironclads or submarines.

The CSS *Shenandoah* was a wooden full rigged sailing ship with an iron frame, and auxiliary steam engine. Formally a merchant vessel from England, she served as a commerce raider. She operated around the globe, trying to disrupt the U. S. Economy, and obtain supplies for the Confederacy. She has the distinction of firing the last shot in anger in the Civil War, across the bow of a whaler in the Aleutian Islands, after the war had ended. News traveled slowly then. She surrendered in the Port of Liverpool to the British Navy.

Shipyards and Facility's

This section discusses the ship building and repair facilities of the combatants. This is not a comprehensive list, and many temporary facilities were used by the South.

Union shipyards

Baltimore

Baltimore had a large infrastructure for building sailing ships, including the famed Baltimore clipper. It easily made the transition to steamships. The Fells Point area is the center for shipbuilding, due to its location at the deepest point of the harbor. It has direct access to the Chesapeake Bay. Maryland was in an awkward position during the Civil war, as it was, technically, a slave state, but the Capital of the Union was located on the south end of the State. Lincoln could not let Maryland secede. Baltimore was served by the Baltimore & Ohio Railroad as well, giving good access to materials and supplies. The USS *Waxsaw* was a single turret, twin screw ironclad, built in Baltimore, MD, by A. & W. Denmead & Son Foundry. They also built the sidewheel gunboat *Monocac*.

Boston

The USS *Canonicus* was built in Boston, and the US *Casco* was built at the Atlantic Works, in the City. Also there was built the USS *Chimo*, at Aquila Adams & Co.

The East Boston Shipyard built the USS *Canonicus* and USS *Quinsigamond*. The USS *Casco* was built at the Bethlehem Atlantic Works, on the East side of the City.

Brooklyn Navy Yard, New York

The Brooklyn Navy Yard was established in 1801, on the East River. During the Civil War, it was not yet a part of the city of New York. In 1861, the yard employed 3,700, growing to 6,200 by the end of the war.

During the war, the Yard built 14 vessels for the Navy, including *Adirondack*, *Ticonderoga*, *Shamrock*, *Mackinaw*, *Peoria*, *Tullahoma*, *Maumee*, *Nyack*, *Wampanoag*, and *Miantonomoh*, and retrofitted more than 400 from civilian usage to the military. Her most interesting build was the USS *Monitor*, the first ironclad, in conjunction with the Continental Iron Works.

Cairo, IL

The CSS *Eastport*, which was a partially complete ironclad, was captured in Tennessee, and converted by the Union forces at Cairo into an ironclad ram. She became part of the Army's Western Flotilla, and she and her sister ships transitioned into the Navy's Mississippi Squadron.

Cincinnati, OH

Cincinnati is on the Ohio River, and provided an ideal spot for riverine ship building. Here, the USS *Yankee* was rebuilt into the CSS *Jackson*. The first three of the *Catawba* class monitors were built here, the USS *Catawba*, USS *Chillicothe*, and USS *Indianola*, as well as the USS *Queen City*. The City and the boatworks changed hands during the war.

Louisville, KY

The USS *Barton* was updated here, and it was the home of James Ead's Missouri Wrecking Company.

Mound City (IL) Naval Station

Mound City served as Admiral Foote's Mississippi River Squadron of some 200 ships, ironclads, timberclads, hospital ships, and transport vessels. The squadron had previously been based at Cairo, but more land was needed. The Navy shops were afloat on wharf boats, old flat boats, and rafts. The squadron moved up river in 1862. The new facility, at Mound City, had some 10 acres. There was a hospital, a foundry, and a shipyard.

The first ironclad ship to be built at Mound City was the USS *Cairo* by a local contractor, James Eads. She led the *City* class of ironclads. The USS *Ozark* was also built there.

Mystic, Ct.

Charles Mallory & Sons Shipyard built the *Owasco*. Another shipyard in Mystic was Maxon, Fish & Co.

New Albany, Indiana

This town had an ongoing steamship industry before the war, and built the ironclad USS *Essex*. There were numerous shipbuilders, due to abundant lumber. Shipbuilding required a lot of trades, such as iron foundry's, machine shops, and wood workers. It was connected by railroad with Lake Michigan.

Philadelphia Naval Shipyard

The shipyard in Philadelphia dates to 1776, and was the U.S.'s first such facility. The Yards repaired the damaged USS *Galena*, built and tested the sub *Alligator* with Neafie & Levy. Merrick & Sons built the *New Ironsides* there.

Pittsburgh

Pittsburgh, on the Ohio River, and a major iron producer was an ideal spot to build ironclads. It did struggle with low water for part

of the year. Its location give it river access to New Orleans. Before the war, there was a thriving industry in building steamers for people and cargo along the river system.

Pittsburgh produced the USS *Marietta*, the *Tomlinson*, and the Tug *Hartuppe*. In addition, Snowdon and Mason, from Brownsville, built two ironclad boats here. See the Vulcan Iron Works section.

New York

New York was the location of a major Navy Yard, and many iron manufacturing firms. The USS *Dictator* was built at Delameter Iron Works. The USS *Kalamazoo* was built at the Brooklyn Navy Shipyard, as was the USS *Miantonomoh*. The USS *Keokuk* was built at J. S. Underhill shipbuilders.

Portsmouth Naval Shipyard

The shipyard is located in Maine, near the New Hampshire city of Portsmouth. It was established in 1800, and is the Nation's oldest continuously operating facility of its type. It was an ideal location near vast forest lands for timber. The first British warship built in the Colonies was at Portsmouth. In the Civil war, it built numerous steam gunboats and monitors.

Vulcan Iron and Machine Works, Brownsville, PA

In 1818, John Snowdon arrived in Brownsville from Yorkshire, England. He apprenticed at a local foundry, and opened his own machine shop and rolling mill. He produced steam engines for the river boats, including the *Monongahela* in 1827. The facility was extended in 1831, but burned in 1853. The replacement facility included a forge, rolling mill, pattern shop, foundry, and finishing shop on an acre of land on the bank of the Mon. The buildings were now constructed of brick.

To quote from Thurston's 1859 Town Directory,

"Within its walls and distributed over the use of two rooms, with

nice regard to their convenient use, is gathered a large amount of machinery, of the latest improvements, adapted to all the requirements of machine manufacturing; among them are 19 turning lathes, 6 planing machines, 4 boring machines and 8 drill presses. There upon the lower floor, 10 blacksmith fires, with all of their accompanying cranes, steam forge hammers, and etc.”

One of Snowdon's early accomplishments was the construction of the first Iron Bridge in America, the Dunlop's Creek Bridge, along the National or Cumberland Road, built west from Cumberland, Maryland, to the Ohio.

Pittsburgh and Cincinnati have good river transportation to the South for their manufactured goods. That mostly ended when the Civil War broke out. The impact on John Snowdon's Iron facility in Brownsville, PA, was devastating. He continued to ship iron products south, but the payments came back in Confederate money of no value. He stopped the shipments and looked around for another line of products to keep the cash flowing. He partnered with a local shipbuilder, Mason to get in on the lucrative war effort in the North. The battle of Hampton Roads had marked the demise of the wooden navies. Mason had only built wooden ships for the river traffic, and Snowdon's Iron facility was too small. They closed their Brownsville operations, and bought some riverfront land in Pittsburgh, next to their major iron supplier Lyon, Shorb & Co. Snowdon brought his best workmen and foremen to the new facility. They had a machine shop on the waterfront, and another in the City. They received contracts for two of the new riverine monitors that the Navy needed, and went on to deliver the *Manayunk* and *Umpqua* from their “Gunboat Yard.” Snowdon, aided by his son William, ran the facility. He sent his foreman of boilermakers to New York City to confer with Ericsson, the inventor of the iconic *Monitor*.

There was a boilershop at the facility, and a skilled boilermaker could make as much as \$3 per day. One of these, Lewis Brown, a wounded veteran of the Gettysburg Campaign, left to a rival who

offered him \$5 per day. Snowdon had to deal with skilled labor shortages, and went so far as to return to England to recruit workers. The *Manayunk* required some 243 skilled workers. Its guns came from Pittsburgh. Multiple changes to the ships were ordered by the government, based on lessons-learned in battle. One of these involved moving the turret, and upgrading the deck armor.

It was ready in April of 1864, but the low level of the river prevented launching. It was successfully launched on December 18, 1864, and eventually made its way down the Ohio to New Orleans, to join the Fleet in 1864. The current was strong, and the large tug *Panther* was required to control it, for a rental fee of \$7,000. Snowdon shipped 400 tons of ship fittings separately. Its trial run was in September of 1865, and it was accepted by the Navy. It was commissioned in September of 1865. The ironclad was assigned to the North Atlantic Squadron, and based at Key West in 1871. It spent a few years at the Philadelphia Navy Yard, and was based at Key West for a while, and at Port Royal, South Carolina.

The other ship, *Umpquo*, wasn't launched until December of 1865, after the war ended. It was never commissioned. It was the last of the ironclads delivered.

There was an overcapacity of boat building facilities after the war, most on or near the coast. In addition, most builders were in litigation with the government about contract terms and payments. Snowdon dissolved the Company in May of 1867, and left Pittsburgh. Mason had died in 1866. A Sheriff's sale of the machine and shop and iron works in Pittsburgh was held to satisfy debts, while the government litigation dragged on. Snowdon & Son, a new company, went back to a machine shop and rolling mill in Brownsville. In 1867, Snowdon retired, and his sons continued the business, and the litigation. The Claims against the government for payment took 20 years to resolve. John N. Snowdon, the surviving partner, got a monetary award 30 years later, in 1893. For the two boats, he received \$118,000 and \$91,000. Some claims for Civil War ironclads were not resolved until World War-1.

The *Umpqua* was laid down in March 1863, and launched in 1865. It was laid up at Mound City, IL. It had a single turret and displaced 1,194 tons. It was 225 feet long, with a 45 foot beam, and 6-foot draft. This class of ship was built with ballast tanks, to allow it to sit lower in the water, after it reached its destination. The ship was sold in New Orleans in 1874 to Nathaniel McKay, and probably scrapped.

The *Manayunk*, later renamed *Ajax*, missed action in the Civil War, but was commissioned in 1869. She served with the North Atlantic Squadron from 1874-1875. She went back into the reserve fleet in 1891. During the Spanish-American War, she was tasked with defending Baltimore. She was decommissioned and scrapped in 1899.

Manayunk was 224 and ½ feet long with a beam of 43 feet. Her maximum draft was just over 13 feet. She weighed a little over 1,000 tons. She had a crew of 100. She had a dual cylinder steam engine, fed by 2 boilers. The engine drove a single propeller. With 320 horsepower, she had a speed of 8 knots. Her armament was two smoothbore 15 inch Dahlgren cannon. Each of these weighed 43,000 pounds, and could send a 350 pound shell to 2,100 yards. The wooden hull was protected by 5 layers of 1 inch plate. The turret and pilot house had 10 layers of 1 inch plate iron. The deck armor was 1.5 inches thick. From lessons learned at the siege of Charleston, the ship had an iron band around the base of the turret to prevent shell fragments from jamming the turret. Another lesson learned and applied was the addition of a “rifle screen” at the top of the turret.

Confederate shipyards

This section discusses some of the shipyards and support industries in the relatively non-industrialized south.

Bordeaux, France

French shipyards built four corvettes, and two ironclad rams for

the Confederacy, but the American minister prevented their delivery. British firms contracted to build two additional ironclad rams, but under threat from the U.S., the British government canceled the order, and bought them for their own navy.

Memphis

The Memphis Yards produced the CSS *Arkansas*, an ironclad ram, as well as ironclads *Arkansas* and *Tennessee*.

New Orleans

The CSS *Louisiana* and *Mississippi* were built at New Orleans. At the near-by Algiers Yard, on the West Bank of the Mississippi, the captured Icebreaker *Enoch Train* was transformed into the CSS *Manassas*. I guess they don't use many icebreakers at New Orleans? Anyway, she received 1.25 inches of plating in a convex shape, which made her look somewhat like a turtle.

Norfolk Naval Shipyard

The Norfolk Naval Shipyard is located on the Elizabeth River, just upriver from its mouth at Hampton Roads. It was originally called Gosport in 1767. In the 1820's, it hosted the first drydock in the United States. It was partially destroyed when the Union Navy pulled out. It was seized by the Confederate Navy, and used to build the CSS *Virginia*, their first ironclad. They also inherited a large amount of useful material, such as 1200 heavy guns. The burned hulk of USS *Merrimac* was found, and rebuilt into the *Virginia*.

Among others, the, CSS *Richmond* and CSS *Wilmington* were built at Gosport.

The Ironclads *Huntsville*, *Phoenix*, *Tennessee*, and *Tuscaloosa* were built in Selma. Both Selma and Richmond's Tredegar facility produced the Brooke's Rifle for Navy use.

Tredegar Iron Works, Richmond

The Tredegar Iron works in Richmond were the largest in the Confederacy. The iron plating for CSS *Virginia* was produced there. Before the War, Tredegar was one of the major iron works in the United States. It produced rail for railroads, and some 70 locomotives. It also produced more than a thousand artillery pieces. At the end of the war, the Tredegar facility petitioned President Johnson for a pardon, which was granted, and the facility was back to work. It produced material and weapons for troops in World Wars I and II.

Richmond hosted the fitting out of the CSS *Richmond*, and the construction of the CSS *Virginia-II*.

Richmond produced the CSS *Fredericksburg* and the CSS *Texas*, at Rockets Naval Yard, with parts supplied from Tredegar.

Confederate Naval Works, Selma

Shelby Iron Works, and Atlanta rolling mill, were second only to Tredegar. It produced shot and shell, gun powder, large cannon, including the Brooke rifle, and ironclad hulls, including the *Huntsville*, *Phoenix*, *Tennessee*, and *Tuscaloosa*. Selma is located on the Alabama River. After the Union troops took the city in April of 1865, the Naval Works and arsenal were burned.

John P. Hillinger in Selma was said to have one of the best foundry's in the South.

A submarine was built at Selma, destination: Mobile Bay. It had an electric motor for propulsion. Name and disposition is unknown.

Yazoo City, Mississippi

The Confederate Navy had a makeshift shipyard at Yazoo city after New Orleans was captured by Union Forces. The shipyard was burned by Union Forces, but the town was retaken by the Confederates. The next year, the Unions forces captured the City

and burned it. The CSS *Mobile* was a wooden sidewheel gunboat, that was to be armored at the Yazoo City facility. The armor was delayed, and the ship was burned to prevent capture.

Wilmington, NC

The CSS *North Carolina* was built here, by Berry & Brothers.

Aircraft Carriers

As long as we're discussing high tech innovations such as ironclads and submarines, we really should throw in the Civil War Aircraft carrier. Stay with me here. Balloons were in use as observation platforms. John Dahlgren got the idea in 1861 that that could be launched from barges. A coal barge, the *George Washington Parke Custis*, was converted into a launch, tether point, and support craft for a balloon at the Washington Navy Yard. It was fitted out with a gas-generating apparatus patented by Lowe, which used carbon and water that was split into carbon dioxide and hydrogen. Lowe was appointed as Chief Aeronaut of the Union Army Balloon Corps by Lincoln.

The balloon-carrier went down the Potomac from the Washington Navy Yard towards Richmond, to observe the enemy, and the fall of shot. It had been used in the first Battle of Bull's Run, Vicksburg, and Fredicksburg. This was the very beginning of Naval Aviation in the United States.

Winans' Cigar ships

In the mid-19th Century, Ross Winans of Baltimore and his son Thomas designed and built a series of spindle-shaped boats, usually referred to as the "Cigar ships". The first was constructed in 1858 and featured an unprecedented (and in the end, technically unfeasible) midship propeller, enclosed in a shroud. This propeller was driven by steam engines located in each hull section. The intent was to allow the ship to proceed with less disturbance from

weather and waves. This ship was discussed at length in the pages of *Scientific American*, and in the end remained tied up at the Winans docks at Ferry Bar, along the north shore of the Middle Branch of the Patapsco River in Baltimore. It was never subjected to sea trials.

There is no evidence that Mr. Winans Cigar ships were ever used in combat, but their influence on design was obvious.

In his own words, “the length of the vessel was more than eleven times its breadth of beam, being 16 feet wide by 108 feet long.” It displaced 350 tons. The ship included two high-pressure locomotive boilers, with steam engines driving a large iron radial propeller with fins amidships. It did achieve a speed of 12 miles per hour on its trial in January of 1859. The ship was lengthened to 194, and then 235 feet. It was shipped to England for further trials, but was never a great success.

Similarly-designed boats were built in St. Petersburg, Russia. The Russian Naval Journal reported on the ships in 1858. William Winans had gained experience in naval construction during the Crimean War, outfitting ironclad gunboats for the defense of St. Petersburg. These predated Ericson's *Monitor* in the U. S. The railroad shops at Alexandrovsky were employed for the Naval work, since it was next to the River Neve.

William L. Winans presented a proposal to the Russian Government entitled, “War Vehicles on the Spindle Principle,” July 1861. This was favorably received by the Grand Duke Nikolaevich, General-Admiral of the Russian Navy. A Winans Cigar boat was tested on the Neva River, and ran to Kronstadt, where it conducted trials in the Gulf of Finland. The Russian Shipbuilding Technical Committee were not impressed.

Winans had proposed three classes of gun boats. One would have a displacement of 500 tons, with dual engines and a single propeller. It was rated for 19 knots, and had 2 retractable deck guns (the

subject of U. S. patent 46516. A thousand ton displacement model would have three guns, and a larger model would have a 3,000 ton displacement. It would have been 504 feet in length, 36 feet in diameter, and carry 6 retractable guns. It was designed to achieve 22 knots, and had six boilers and four engines, fore and aft. The armor would range from 4 inches to 21 inches.

The ships were of concern to the Union, during the Civil War, and were placed under guard.

Winans also proposed his ironclad Cigar ships to the U. S. Minister to Russia for what he saw as a looming conflict with England. These would be the same basic design as the Russian ships, but with improved smoke stacks that could slide down into the hull. Nothing came of this.

William Winans took his cigar boat construction to England with his experimental Russian craft loaded on the British steamboat *Nautilus*. He had another cigar ship built in Le Havre, France, the *Walter S. Winans*, by M. M. Nilus & Son. A crossing of the Channel in 1866 is documented in *The Manchester Guardian*. He constructed a private yacht for himself in England, the fourth cigar ship, the *Ross Winans*. It displaced 166 tons, later increased to 250 tons, and was 130 feet long. It had 22 foot 9-bladed propellers at each end. It was launched in 1866 on the Thames. It included a salon with fine wood paneling and crystal chandeliers. It was outfitted by Holland & Sons, suppliers of furniture to the Royal Family. It had 4 boilers with 120 vertical tubes, and used a superheater to produce dry steam at 500 degrees. It operated on sea water, and used a condenser. It featured three vertical cylinders, 24 inches in diameter with a four foot stroke, driving a crankshaft. There was a seven and a half inch shaft running through the length of the ship, which was 230 feet. It ran at 40-45 rpm, but had been tested, out of water, at 75 rpm. It had a unique ballast engine, a 12-ton moving weight system that would balance out the ship's roll. The cigar ships did not have a keel. The ship was constructed by Jackson & Watkins of the Canal Ironwork. Winans wanted to

register his yacht at the Imperial Saint Petersburg Yacht Club. Numerous problems preventing the ship making the voyage.

None of these were also put to full sea trials, though press reports survive of trips in the Solent and the English Channel. The ships were moored near Southhampton on the Thames until they were scrapped around the turn of the century, according to Guthrie. However, Whistler's mother was a guest of Walter Winans on an excursion to the Isle of Wright in 1876.

There is the possibility that these ships were the basis for Jules Verne's *Nautilus*.

One of Winans' strange Cigar ships remained tied up at the Winans docks along the north shore of the Middle Branch of the Patapsco River in Maryland. The original Cigar ship with the central propeller was tied up next to it. There is a description of that boat from George Harding, or the 21st Regiment, Indiana Volunteers in September of 1861. They were camped at Locust Point, and toured the ship.

The other Cigar ship, called the *Water Task* concerned Flag Officer L. M. Goldsborough enough that he wrote a letter of concern that "the infernal machine" could become a weapon for the Confederacy to the Secretary of the Navy. It was then guarded by Company F of the 2nd Maryland Infantry for a while. On October 19, 1861, the tug *Ajax* brought the strange ship to Hampton Roads. The U. S. Navy and the Army at Fortress Monroe were again concerned. It was said that the ship was there for experiments on whether seawater would be better in high pressure boilers, or if it caused a greater build-up of boiler scale. Evidently, one sampling expedition was conducted, and nothing more is heard about the ship.

The Sachse Map of Baltimore, 1869, Library of Congress, shows two Winans ships docked in the Patapsco, at a location marked "Winans Shipyard."

Although Winans did not seem to try to sell his machinery directly to the southern States, they were well aware of his work. A maker of torpedo boats, Dr. St. Julian Ravenel supposedly used the Winans model as his prototype. "Dr. Ravenel said it had occurred to him that a boat built on the pattern of the Winans Steamer in Baltimore would be particularly well-adapted for the purpose of attacking the fleet with torpedoes, recalling descriptions of the Winans boat which he had read, I believe, in *Scientific American*."

After the War

After the war ended, there was no more need for wooden ships. Ironclads were seaworthy, and much in demand. Two went to Peru, around the Horn. The River Monitors *Catawba* and *Oneota* became the *Atahualpa* and the *Manco Capac*. First-generation ironclads were getting dumped at fire sale prices, and other countries bought them for prestige or to impress or intimidate the neighbors. Some units went to France. Ericcson went on to design some 30 small gunboats for Spain. The Spanish-America war, and World Wars One and Two featured new inventions, practical submarines, Dreadnoughts, and aircraft carriers. The ensuing cold war evolved nuclear powered submarines and ballistic missiles. Naval engineering continues to evolve.

Technological significance

Numerous technological innovations during the Civil War had a great impact on 19th-century science in general. The Civil War was one of the earliest examples of an "industrial war", in which technological might is used to achieve military supremacy. Technology in general and civilian use was advanced by the war. Its a shame that war has to be used as a technology challenge. Today, keeping the peace is driving innovation. Let's hope it stays that way.

Where are they now?

There are only four surviving Civil War-era ironclads known to be

in existence, USS *Monitor*, CSS *Neuse*, USS *Cairo*, and CSS *Jackson*.

The USS *Monitor* was found and salvaged. It is being stabilized, and is in the Mariners' Museum Park in Newport News, VA. There is a memorial dedicated to the crew in the Hampton National Cemetery, Hampton, VA.

The CSS *Hunley* (sub) was located in 1995, and recovered in 2000. It is in the Warren Lasch Conservation Center Museum in North Charleston, South Carolina.

The USS *Cairo*, an example of a Union City-class Ironclad, was recovered, and is in the Vicksburg National Military Park in Mississippi.

There is a memorial to John Ericsson in Washington, D. C. at Independence Avenue and Ohio Drive, near the Lincoln Memorial.

The CSS *Neuse* (sub) is at the Civil War Interpretive Center in Kinston North Carolina.

The submarine CSS *Bayou St. John* is at the Capital Park Museum in Baton Rouge. This may actually be the *Pioneer*.

A model of the CSS *Pioneer* submarine is located at the Lake Pontchartrain Basin Maritime Museum, in Madisonville, Louisiana.

The submarine USS *Intelligent Whale* was on display at the Washington (D. C.) Navy Yard. She currently resides at the National Guard Militia Museum of New Jersey in Sea Girt.

You can't quite see them yet, but two Confederate torpedo boats of the CSS *David* type may be under Charleston's Tradd Street, according to a National Geographic ground penetrating radar scan.

At the Washington (D. C.) Navy Yard, in Willard Park, are four

Brooke rifled cannon from the CSS *Atlanta*.

Two pair of Brookes rifles from the USS *Tennessee*, formally the CSS *Tennessee*, are on display as well. These are in the East Willard Park of the Naval Yard in Washington, D.C. One of her Brookes rifled cannon is on display in Norfolk, at the HQ, Commander-in-Chief, U.S. Atlantic Command. Another Brooks rifle is on display at the Selma, Alabama City Hall.

USS Cairo has been recovered, and is in the Vicksburg National Military Park.

Glossary of Terms

Aft – towards the stern of the ship.

Beam – width of vessel at widest point

Bow – front of the ship.

Brown water Navy – operating in riverine environments. Bulwark -

Burthen – cargo capacity of a ship, calculated from size.

Bulwark – projection out from a fortification wall.

Canister - an anti-personnel artillery round.

Casemate – armored gun emplacement.

C-in-C – Commander in Chief.

Cascabel – at the rear of a cannon, used to attach restraining ropes.

Catamaran – boat with dual hulls.

Cottonclad – bales of cotton to deflect shot. Use what you have.

Dahlgren gun – Union

DANFS – Dictionary of American Naval Fighting Ships.

David – a semi-submersible.

Draft, or Draught – distance from the keel to the waterline.

Fathom – unit of depth of water, equals 6 feet.

Foundered – capsized.

Freeboard – distance from the waterline to the upper deck.

Glacis – artificial slope.

Grape shot – an anti-personnel artillery round.

Gun boat – smaller vessel, used for bombardment. Can be armored.

Howitzer – short barreled artillery piece for firing at high angles.

HQ - headquarters

“In ordinary” - out of service for repair.

Jon boat – small, flat-bottomed boat.

Keelson - a centerline structure running the length of a ship mounting the transverse members of the floor to the keel.

Knot – unit of speed, nautical mile per hour, 1.15 miles per hour.

Larboard – archaic word for Port, or left.

Littoral – close to the shore.

Monitor – warship of the USS Monitor design.

NNSY – Norfolk Navy Ship Yard

NOAA – (U.S.) National Oceanographic and Atmospheric Administration.

NUMA – (U.S.) National Underwater and Marine Agency.

Pdr – pounder, referring to weight of shot.

Port – left side of a vessel

Ram – warship that would ram other vessels.

Riverine warfare – military operations in rivers.

Schooner – ship with two or more masts, and fore-and-aft sails.

Shrapnel – anti-personnel fragmentation shell.

Snagboat – used to remove obstructions and snags from a river.

Spar deck – the uppermost deck.

Starboard – right side of the vessel.

Stem – front of the ship.

Stern – rear of the ship, located aft.

Timberclad – extra heavy timbering of a ship when iron wasn't available.

Tinclad - A lightly armored steam-powered river gunboat used during the American Civil War.

Trunnion – cylindrical protrusion used as pivot point. Used with cannons.

Tumblehome – narrowing of a ships hull with distance above the waterline.

USRC – United States Revenue Cutter. An armed customs enforcement agency.

References

Baxter, James Phinney *The Introduction of the Ironclad Warship*, (CLASSICS OF NAVAL LITERATURE), 2000, Harvard University Press, ISBN – 978-0674730700.

Bearss, Edwin C. *Hardluck Ironclad: The Sinking and Salvage of the Cairo*, Baton Rouge, Louisiana: Louisiana State University Press, 1966.
<https://academic.oup.com/jah/article/54/2/412/750038>.

Bigelow, John (1888). *France and the Confederate Navy, 1862–1868*. New York, Harper & brother

Bisbee, Saxon T. *Engines of Rebellion: Confederate Ironclads and Steam Engineering in the American Civil War*, 2018, ISBN-0817319867.

Campbell, R. Thomas *Confederate Ironclads at War*, 2019, ISBN-1476676402.

Canney, Donald L. (1993) *The Old Steam Navy: The Ironclads, 1842–1885*, Naval Institute Press. ISBN-0-87021-586-8.

Chaffin, Tom *The H. L. Hunley: The Secret Hope of the Confederacy*, 2010, ASIN-B003AYZB5M.

Crandall, Warren Daniel; Newell, Isaac Dennison, *History of the ram Fleet and the Mississippi Marine Brigade in the war for the Union on the Mississippi and its Tributaries. The Story of the Ellets and Their Men*, 2017, ISBN-1375851462.

Elliott, Robert G. *Ironclad of the Roanoke: Gilbert Elliott's Albemarle*, 2005, ISBN-1572493747.

Emerson, William C. "USS New Ironsides: America's First Broadside Ironclad" In Gardiner, Robert (ed.). *Warship* 1993. London: Conway Maritime Press, ISBN-0851776248.

Gibbons, Tony *Warships and Naval Battles of the Civil War*, 1989, ISBN-8317-9301-5.

Gosnell, Harper Allen. *Guns on the Western Waters: the story of River Gunboats in the Civil War.*, Baton Rouge: Louisiana State University Press, 1993, ISBN-978-0807118900.

Hicks, Brian, Kropf, Schuyler *Raising the Hunley: The Remarkable History and Recovery of the Lost Confederate Submarine*, 2007, ASIN-B000XUACUK.

Holloway, Anna Gibson; White, Jonathan W. *Our Little Monitor: The Greatest Invention of the Civil War*, 2018, ISBN-1606353144.

Holzer, Harold (ed); Mulligan, Tim (ed) *The Battle of Hampton Roads: New Perspectives on the USS Monitor and the CSS Virginia*, 2006, ISBN-0823224813.

Hulbert, Archer Butler *The Paths of Inland Commerce: A Chronicle of Trail, Road, and Waterway*, New Haven, CT: Yale University Press, 1921, reprinted, Echo Library, 2009, ISBN-1406850624.

Joiner, Gary D. *Mr. Lincoln's Brown Water Navy: The Mississippi Squadron*, Rowman & Littlefield, 2007, ISBN – 0742550982.

Joyner, Elizabeth *The USS Cairo: History And Artifacts of a Civil War Gunboat*, 2006, ISBN-0786422572.

Konstam, Angus *Confederate Ironclad 1861-65*. Osprey Publishing. 2001, ISBN- 9781841763071.

Konstam, Angus, *Mississippi River Gunboats of the American*

Civil War 1861–65, Osprey, ISBN-9781841764139.

Konstam, Angus, *Union River Ironclad 1861–65*, 2002, Osprey, ISBN – 9781841764139.

Konstam, Angus, *Union Monitor 1861-65*, 2002, Osprey, ISBN-97841763064-18.

Marvel, William (ed) *The Monitor Chronicles: One Sailor's Account: Today's Campaign to Recover the Civil War Wreck*, Mariner's Museum, 2000, ISBN-0684869977.

McBride, Robert *Civil War Ironclads: The Dawn Of Naval Armor*, 2015, ASIN-B06XGMLMXT.

Melton, Maurice *The Confederate Ironclads*, 1968. Thomas Yoseloff Ltd., ASIN-B01FIYQSYE.

Milligan, John D. *Gunboats down the Mississippi*, Annapolis: United States Naval Institute, 1965, ISBN-0870212427.

Mindell, David A. *Iron Coffin: War, Technology, and Experience aboard the USS*, JHU Press, 2012, ISBN-978-1421405209

Nelson, James L. *Reign of Iron: The Story of the First Battling Ironclads, the Monitor and the Merrimack*, 2005, ISBN-0060524049.

Nicaud, Tristan *The Journal of William Swiss: A Sailor on the Ironclad "Virginia"*, 2019, ISBN-198094878X.

Olmstead, Edwin; Stark, Wayne E.; Tucker, Spencer C. *The Big Guns: Civil War Siege, Seacoast, and Naval Cannon*, 1997, Museum Restoration Service, ISBN-88855-012-X.

Quarstein, John V. *The Monitor Boys: The Crew of the Union's First Ironclad*, 2015, ASIN-B00XRG2TCQ.

Quarstein, John V. *The CSS Virginia: Sink Before Surrender*, 2013, ASIN-B00XRFU0ZA.

Quarstein, John V. *Iron Dawn: The Monitor, the Merrimack, and the Civil War Sea Battle that Changed History*, 2016, ASIN-B01CO34H90.

Ragan, Mark *Union and Confederate Submarine Warfare in the Civil War*, 1999, ISBN-1882810325.

Roberts, William H. *Civil War Ironclads: The U.S. Navy and Industrial Mobilization (Johns Hopkins Studies in the History of Technology)*, 2007, ISBN-0801887518.

Silverstone, Paul H. *Civil War Navies 1855–1883*, The U.S. Navy Warship Series, 2006, ISBN 0-415-97870-X.

Smith, Myron J. *The USS Carondelet: A Civil War Ironclad on Western Waters*, 2010, ISBN-0786445246.

Smith, Myron J. *The CSS Arkansas: A Confederate Ironclad on Western Waters*, 2011, ASIN-B00602L8LC.

Smith, Myron J. *The Timberclads in the Civil War: The Lexington, Conestoga and Tyler on the Western Waters*, 2008, McFarland & Company. ISBN-9780786435784.

Smith, Myron J. *Joseph Brown and His Civil War Ironclads: The USS Chillicothe, Indianola and Tuscumbia*, 2017, ISBN-0786495766

Smith, Myron J. *Tinclads in the Civil War: Union Light-Draught Gunboat Operations on Western Waters, 1862-1865*, 2010, ASIN-B00AB3ITOA.

Snow, Richard *Iron Dawn: The Monitor, the Merrimack, and the Civil War Sea Battle that Changed History*, 2016, ASIN-

B01CO34H90.

Stakem, Patrick H. *Ross Winans, an Ingenious Mechanic of Baltimore*, 2017, PRRB Publishing, ASIN- 1520207298.

Stempel, Jim *The CSS Albemarle and William Cushing: The Remarkable Confederate Ironclad and the Union Officer Who Sank It*, 2011, ISBN-0786465298.

Still, William N., Jr. *Iron Afloat: The Story of the Confederate Armorclads*, 1985, University of South Carolina Press., ISBN 0-87249-454-3.

Thulesius, Olav *The Man Who Made the Monitor: A Biography of John Ericsson, Naval Engineer*, 2007, ISBN-0786427663.

Winans Cigar Ships

Cottom, Robert I. (ed) "Cigar Boats," Maryland Historical Magazine, Vol 93, No. 4, Winter 1998, mdhs.msa.maryland.gov

Guthrie, John *Bizarre Ships of the 19th Century*, A. S. Barnes, 1970, ISBN-0498078396.

Verne, Jules *Twenty Thousand Leagues Under the Sea*, 1870, reprinted, Ancient Wisdom Publications, 2013, ISBN-1940849063.

"Launch of the Steam Yacht *Ross Winans* at Millwall," The Illustrated London News, March 3, 1866, <http://gdc.gale.com/products/illustrated-london-news-historical-archive-online>.

"The Machinery of the *Winans Yacht*," *The Engineer*, March 9, 1866, United Kingdom National Institute of Mechanical Engineering.

www.vernianera.com/CigarBoats.html (a large list of primary and

secondary references)

<http://io9.gizmodo.com/which-real-life-victorian-sub-inspired-jules-vernes-na-458345856>.

Lamb, John *A Strange Engine of War: The "Winans" Steam Gun & Maryland in the Civil War*, Chesapeake Book Company, 2011, ISBN-0982304927.

Resources

<https://www.minecreek.info/confederate-ironclad/cascoclass-monitor-technical-specifications.html>

<https://www.minecreek.info/confederate-ironclad/richmondclass-ironclad-technical-specifications.html>

<https://www.minecreek.info/confederate-ironclad/uss-merrimack.html>

<https://www.minecreek.info/hurricane-deck/metal-parts.html>

<https://www.minecreek.info/confederate-ironclad/chronology.html>

<https://www.monitorcenter.org/>

<https://www.history.navy.mil/research/archives.html>

<http://www.navyandmarine.org/ondeck/1862submarines.htm>

Steam Yacht *Ross Winans*, Sept 23, 1865 (avail. U. Mich. Library)

United States, Naval War Records Office, 1900. "Official Records of the Union and Confederate Navies in the War of the Rebellion," multiple volumes. Available through the Government Printing Office.

“Submarine Engines,” *Army and Navy Journal*, March 19, 1864,

Most of the mechanical drawings of the ironclads are maintained at the National Archives, www.archives.com.

Wikipedia, various.

If you enjoyed this book, you might also enjoy one of my other books.

Stakem, Patrick H. *Cumberland & Pennsylvania Railroad Revisited*, 2011, PRRB Publishing, ASIN B004J8HUAM.

Stakem, Patrick H. *Eckhart Mines, The National Road, and the Eckhart Railroad*, 2011, PRRB Publishing, ASIN B004KSQVWO.

Stakem, Patrick H. *The History of the Industrial Revolution in Western Maryland*, 2011, PRRB Publishing, ASIN B004LX0JB2.

Stakem, Patrick H. *Down the 'crick: the Georges Creek Valley of Western Maryland*, 2014, PRRB Publishing, ASIN B00LDT94UY.

Stakem, Patrick H. *Lonaconing Residency, Iron Technology & the Railroad*, 2011, PRRB Publishing, ASIN B004L62DNQ.

Stakem, Patrick H. *T. H. Paul & J. A. Millholland: Master Locomotive Builders of Western Maryland*, 2011, PRRB Publishing, ASIN B004LGT00U.

Stakem, Patrick H. *Tracks along the Ditch, Relationships between the C&O Canal and the Railroads*, 2012, PRRB Publishing, ASIN B008LB6VKI.

Stakem, Patrick H. *From the Iron Horse's Mouth: an Updated Roster from Ross Winans' Memorandum of Engines*, 2011, PRRB

Publishing, ASIN B005GM4012.

Stakem, Patrick H. *Iron Manufacturing in 19th Century Western Maryland*, 2015, PRRB Publishing, ASIN B00SNM5EIU.

Stakem, Patrick H. *Railroading around Cumberland*, 2012, Arcadia Press, ISBN- 0738553654.

Stakem, Patrick H. *Cumberland (Then and Now)*, 2012, Arcadia Press, ISBN-0738586986 , ASIN B009460QNM

Stakem, Patrick H. *Fort Cumberland, Global War in the Appalachians: a Resource Guide*, 2012, PRRB Publishing, ASIN-B0088BWK06.

Stakem, Patrick H. *Ross Winans, an ingenious mechanic of Baltimore*, 2017, PRRB Publishing, ASIN- 1520207298.

Stakem, Patrick H. *Mount Savage, Iron Empire*, 2016, ISBN-978-1549650413.

Stakem, Patrick H. *Studebaker Wagons*, 2018, ISBN-978-1091464902 .

2019 Releases

Stakem, Patrick H. *Submarine launched Ballistic Missiles*.